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Designing Work for Online-Offline Service Integration through Process Mining: A Case of Food and Beverage Business in Bangkok Metropolitan Area

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Abstract

Modern service businesses must enhance their capability to operate and manage efficiently within the Future of Work framework. The advent of digitalization and artificial intelligence does not only play a part in the application of technology but also influences the way services are provided. Designing and improving service processes must consider the aspects of workforce augmentation due to the inevitable higher degree of interaction between service providers, technology, and customers. This study collected data on 6,520 recorded events within customer orders from 1,630 customers over a one-month sales period. The data were gathered from the point-of-sale system and combined with surveillance data from that period. The samples of event records, sales data (customer orders), and surveillance data were then analyzed using a process mining approach. Service processes and tasks performed by employees when providing services to the customers, interacting with the point-of-sale system, and facilitating customer payments in online and offline manners were analyzed to enable the discovery of work patterns and the acquisition of valuable insights aimed at enhancing service provision. The results showed that throughput time per customer order increases by 41.4% when services operate under online-offline mode. Inefficient activities when the staff work collaboratively consist of online order processing, offline customer service, online customer service, online-offline customer order taking, and online-offline customer payment. The findings are useful for the business in designing new workflows that foster appropriate levels of interaction and augmentation for its service delivery.

Keywords: Service process, Online-offline service integration, Process mining, Work design

Introduction

In manufacturing settings, there has been a significant emphasis on extensive research and development concerning the augmented workforce and systems that interact with operators. The purpose is to complement, enhance, or supplement their cognitive or physical abilities when performing a diverse range of tasks (Moencks, Roth, & Bohné, 2020). In contrast, service operators tend to rely on a relatively lower degree of assistance systems due to the unique characteristics of their work, economies of scale, and technological requirements. However, the interaction between service operators and devices or systems during service provision necessitates

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meticulous attention in the design of service work to ensure seamless operations and satisfactory performance. Recent studies have primarily concentrated on the design of work in artificial intelligence-based services (Zhao & Fu, 2022), the adoption of an employee-centered design approach for human-technology collaboration (Reinhard, Li & Leimeister, 2022), and the human-centered design of Hybrid Intelligence Systems to facilitate organizational augmentation efforts (Poser et al, 2022). These studies underscore the utmost significance of employing augmentation strategies in service design and work design.

Typically, the design of work in service industries is predominantly centered on achieving service performance objectives and fulfilling specific requirements. Redesigning work processes within the modern service context, the food and beverage services in particular, requires comprehensive knowledge encompassing various aspects of service design, including distinct stages of service processes, points of encounter and interaction, flow of service, and subsequent service performance outcomes. Unfortunately, the crucial aspects of human-technology interaction and collaboration in service settings often receive inadequate attention. This gap can be fulfilled by thoroughly examining the characteristics and patterns of interaction and collaboration in the service processes.

Purpose

The objectives of this study consist of; (1) examining the flow of services and the tasks performed in both online, offline, and online-offline modes; (2) collecting and retrieving the event logs and sales data from the Point of Sale (POS) system and consolidating them with surveillance data; (3) investigating the patterns of work in terms of interaction and collaboration, and analyzing the related service performance using a process mining approach; (4) propose a work design for online-offline service integration for better improving service performance and related workforce augmentation aspects. This study illustrates how data-driven research approaches, such as process mining, can be effectively utilized to analyze service processes and elucidate their inherent characteristics and patterns. These findings, in turn, facilitate informed decision-making regarding work design, leading to improved practices and outcomes within the service sector.

Literature Review

Online-Offline Service Integration

Incorporating technology for service integration offers service businesses opportunities to better respond to emerging market conditions through various means, including reductions in management costs, the preservation and acquisition of loyal customers, and the attainment of a unique and differentiated market positioning. A notable instance lies in the retail sector, where escalating interest is observed in deploying advanced in-store systems to enhance the shopping experience. Such systems offer customers innovative tools that engage them by providing deeper insights, saving time, and fostering a sense of independence while shopping (Savastano et al., 2019). The exploration of channel integration has been extensively conducted with a predominant focus on customer perspectives (Herhausen et al., 2015). The integration of online and offline channels in services exhibits distinct effects on customer purchasing behavior and their overall buying experiences (Swoboda & Winters, 2021). Equally significant is comprehending how channel integration influences the performance of service providers. Notably, the integration of online and offline services can generate heightened demand for service providers, particularly those of a professional nature.

Most online activities are intentionally designed to be convenient, cost-effective, responsive, and user-friendly. As a result, online customers are often less inclined to compromise on the quality of service compared to offline customers. It becomes challenging to satisfy online customers by requesting them to avail offline services unless necessary (Ye & Wu, 2023). Offline activities, on the other hand, can provide support and complement the online services. For example, customers who make online purchases can seek direct assistance from in-store staff or return their products through designated drop-off points. In situations where offline customers are present on-site, online services may be redundant and unable to cater to their needs effectively. In the context of the food and beverage industry, challenges surface concerning the integration of both online and offline services, as customers have the flexibility to access services through various channels based on their search preferences and exposure. Likewise, they have the option to exit the services using either online or offline channels, as predetermined during the service design stage.

The goal for firms is to establish congruent channels, wherein structures and offerings are synchronized across different channels. The consistency of the customer experience across channels is recognized as a crucial aspect for omni-channel retailers (Swoboda & Winters, 2021). However, there has been limited research on how online-offline interactions impact the work performance of service providers. It is valuable to explore how the integration of online and offline services influences the overall service level and the work performance of service providers, considering their potential implications for workforce productivity and efficiency in omnichannel settings.

Work Design

Within the service context, there exists a clear connection between employees, customers, and technology. The value generated by a service-oriented business is a result of the interaction between customers and service providers. This interaction encompasses the holistic experience that customers undergo during the service provision process (Tynan & McKechnie, 2009). The work design within this context is a tangible element that significantly impacts the outcomes of service provision. Recognizing the importance of work design is essential in effectively managing service delivery processes. The quality of workflow design holds the key to the subsequent performance of the entire service process and profoundly influences customers' perceptions of the value derived from the service (Wang, Chen, & Hsien, 2013).

A value chain perspective necessitates the explicit consideration of human-centered design principles when designing and procuring technologies. In addition to focusing on upskilling employees, there is a recognized need to provide training to employees and other stakeholders on work design and related topics (Parker & Grote, 2022). An example of this is evident when service operators function as agents within artificial intelligence service systems. In such cases, the design of work must ensure the presence of skill variety, job identity, and a balanced workload. Service operators are no longer mere users of technology but instead interact with AI-mediated crowds of experts for knowledge reference and transfer, while still retaining their autonomy and decision-making control. Consequently, technology design should emphasize autonomy, control, agency, and skill variety.

Although achieving this interaction can be time-consuming, particularly in services where dedicated technology development necessitates substantial resources and investments, it is crucial to acknowledge that human-technology interaction and collaboration may be compromised. In the presence of such gaps, work design should focus on leveraging an augmented workforce and exploring alternative approaches to cultivate effective collaboration between humans and technology.

Augmented workforce and Human-Technology Interaction and Collaboration

The design of an augmented workforce, aiming to enhance cognitive abilities like inductive reasoning, as well as physical abilities, holds significant importance. However, the acceptable forms of augmentation can vary (Moencks, Roth, Bohné & Kristensson, 2022). Within the service context, the use of human-artificial intelligence interaction and collaboration has shown growth, particularly in the utilization of chatbot assistance and recommendation systems. Effective design of these systems should focus on improving both cognitive and physical abilities. Understanding the relevant factors that impact the effectiveness of work design is critical, especially in relation to augmented workforce and human-technology collaboration. Baptista et al (2020) present a layered progression of workplace technologies, consisting of individual tool layers, group and community layers, and intelligent augmentation layers. Within these layers, certain tasks can be automated, eliminating the need for human involvement. However, it is important to note that organizations are moving towards automation only in specific cases. Human work remains crucial, and efforts to integrate automated processes within human activities, or vice versa, continue to be essential. It is vital to comprehend how technologies are reshaping organizational work, which work functions are being transformed, and the potential for such transformations to disrupt established structures within organizations.

Workforce strategies in organizations are typically developed independently from digital strategies. Often, they are reactive and constrained by shorter-term planning horizons. While detailed and mature architectural blueprints for digitization, automation, AI, and process optimization may exist, there may not be a corresponding workforce strategy overlay that aligns with technological and architectural shifts, and the resulting shifts in the workforce that may occur over time (Farrow, 2022).

Process Mining in Services

The utilization of the data mining approach has found applications in the domain of service businesses. Liao, Widowati, & Lin (2021) exemplify this by employing a knowledge map to identify meal patterns and customer preferences for managing restaurant hospitality. This approach enables a deeper understanding of distinct customer preference clusters, thereby assisting in the development of restaurant business models. Furthermore, process mining has been employed to investigate service behaviors (van der Aalst, 2012) and uncover organizational inefficiencies (De Weerdt et al., 2013). By utilizing process mining techniques, inefficiencies within service businesses can be identified instead of relying solely on simulation models. Multiple perspectives derived from process mining are integrated to identify and address these inefficiencies (Rozinat et al., 2009).

The methodology and analysis employed in process mining involve modeling processes using event graphs derived from workflow logs that encompass comprehensive information on the control-flow, data, and resource aspects of a business process (Liu et al., 2012). The process comparator can generate variant analysis output and identify differences that cannot be explained or linked to the initial observations derived from process discovery. These discrepancies may be attributed to the volume and variability of behavior recorded in the event logs. However, it should be noted that process mining techniques currently do not automatically analyze event log information that is not directly related to process behavior and control-flow (Augusto et al., 2022). Hence, a limitation persists, necessitating process analysts to integrate process mining analysis with data mining analysis.

To enhance service performance, there is further potential for advancing the digitalization of the service process (Kurganov et al., 2021). Ahmadon & Yamaguchi (2021) developed a customer preference model utilizing associative mining, alongside a consumer behavior model expressed as a workflow net obtained through process mining. This approach involves mining association rules that correspond to the workflow of a service and implementing a cut-off process to derive the preferred workflow.

As services continue to evolve, encompassing both online and offline channels and activities (Ryu, Lim, & Kim, 2020; Huang, Yan, & Yin, 2021), there is potential value in leveraging process mining to enhance service operations, particularly when online and offline processes involve distinct forms of employee and machine interaction. Process mining can unveil work patterns and specific behaviors associated with different outcomes. Consequently, organizations can use this information to develop new service processes and design workflows that facilitate higher levels of service digitalization.

Methodology

To develop a practical case study on work design using a process mining approach, the subject of food and beverage service was selected as a real-life example. In Thailand, the food and beverage businesses have adopted a wide range of digital systems; however, employees continue to play integral roles in the service delivery systems. Their involvement necessitates dynamic responses aligned with the prevailing values, purpose, and intent within the organization, a concept referred to as structural digital work (Baptista et al., 2020).

This case study represents a typical profile of small to medium-sized food and beverage businesses in Thailand. It encompasses a combination of offline and online services, a limited number of service operators, ambiguous workload assignments, reactive customer interactions, and minimal utilization of technology. The product offering primarily comprises pre-cooked dishes that are ready to serve. The business operates during two-time windows, namely 6 am to 12 pm and 3 pm to 8 pm, except for closing at noon on Fridays. For each time slot, two key staff members are responsible for all front-end tasks. Both offline and online service channels are available to accommodate various customer orders, including dine-in, takeaway, and delivery. The flow of services and the tasks performed in both online and offline capacities are illustrated in Figure 1.

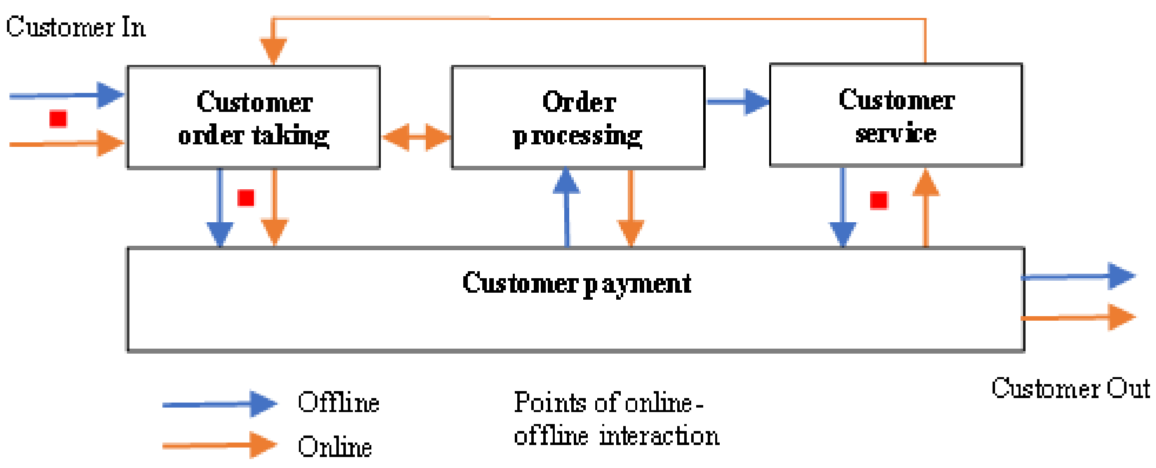

Figure 1 Flow of online and offline activities in the service

The selected service processes for analysis include customer order receiving, order processing, order fulfillment, customer assistance, and customer payment in their online, offline, and online-offline forms. The specific tasks performed by the staff members are listed in Table 1.

Table 1 Description of works for online, offline and online-offline modes

No.	Process	Offline	Online	Online-offline
1	Customer order taking	The staff greets customers, shows them the menu, and takes their orders. The orders are then reviewed and sent to the chefs. In certain instances, the staff members may also assist in the preparation of the dishes if they are available for this task.	The staff receives incoming online customer orders, which are then submitted to the point-of-sale (POS) system. The POS system processes the orders and generates corresponding order notes for further handling.	The staff receives phone calls from online customers and takes necessary actions to accommodate their requests, including adjusting orders as per customer preferences.

Table 1 Description of works for online, offline and online-offline modes (cont.)

No.	Process	Offline	Online	Online-offline
2	Order processing	The staff prepares the dishes utilizing pre-cooked ingredients and serves them to the customers. Additionally, during idle periods, the staff assists with customer order taking, attends to their needs, and facilitates the check-out process.	When orders cannot be processed due to raw material shortages or equipment problems, the staff members make necessary adjustments or cancellations in the food delivery application.	There are no interrelated online and offline activities involved in the processing of orders.
3	Customer service	Staff members attend to customers in a random manner, catering to their specific requests and addressing any inquiries they may have.	The food delivery application serves as a customer service channel through which staff members can access valuable feedback, ratings, and reviews provided by customers.	Staff members establish contact with customers through phone calls and the application interface, particularly in situations requiring order corrections or cancellations.
4	Customer payment	The staff members proceed to the payment counter to operate a point-of-sale machine.	Staff members are not required to directly engage in online customer payment activities.	Customers have the option to make payments for a particular order using multiple methods, such as cash, QR code scanning, or mobile banking transfers. The staff members handle the various bills associated with these different payment methods.

Throughout the service, there are several instances where staff members engage in multitasking, conducting both online and offline activities simultaneously. Event logs and sales data from the Point of Sale (POS) system, and surveillance data from in-store recording cameras are collected, recorded, retrieved, and consolidated. An example of the collected data is illustrated in Table 2. It should be noted that each staff member may perform multiple activities, and various staff members may be involved in activities related to each customer. Timestamps are recorded with customer ID, staff members, and their corresponding activities. The event logs and sales data were validated daily to confirm the match between customer transactions and all receiving cash and online payment amounts. The surveillance data consolidated with the event logs were also reviewed daily to ensure the coverage and accuracy of the timestamp of each activity in every customer transaction.

After examining the research conducted on process mining methodology and its application in service settings, it becomes evident that there are abundant opportunities to delve into the exploration of service businesses through the utilization of process mining. This exploration can be realized by integrating new data that encompasses the emergence of novel service processes, operations, and behavioral patterns associated with service delivery models. The ARIS Process Mining tool is employed for data analysis in process mining. The event log utilized in this context comprises a total of 1,630 instances of customer orders, encapsulating 6,520 activities. On average, there are 217.33 activities initiated daily, resulting in an average of 4 activities per case. Notably, the event log encompasses all invoices processed during the period from November to December 2023. Subsequently, the invoices were traced back to their respective activities for further examination and analysis.

Table 2 Data collected for process mining

Customer ID	Timestamp	Sales value	Channel type	Activities	Staff
DY701	11/06/23 06:59	75	D	Online COT	A
DY701	11/06/23 06:59	75	D	Offline OP	B
DY701	11/06/23 07:03	75	D	Online CP	Online
2MTXE	11/06/23 07:15	125	DI	Offline COT	A
2MTXE	11/06/23 07:16	125	DI	Offline OP	B
2MTXE	11/06/23 07:20	125	DI	Offline CS	A
2MTXE	11/06/23 07:23	125	DI	Offline CP	B
1H7P1	11/06/23 07:18	45	TA	Offline COT	A
1H7P1	11/06/23 07:19	45	TA	Offline OP	B
1H7P1	11/06/23 07:24	45	TA	Offline CS	B

Results

A performance sequence analysis was conducted to examine the patterns of work conducted in the context under study (see Figure 2). This analysis reveals distinct patterns in the interactions among service providers, systems, and customers. The existing processes have a multitude of connections and workflows, which vary depending on factors such as customer order types, service channel types, staff availability, and customer payment preferences. The outcomes of this process extraction serve as a starting point for gaining a deeper understanding of the service processes.

Process mining was utilized to determine the average cycle time of overall cases, activities performed by staff A, and activities performed by staff B (as shown in Table 3). Particularly, upon comparing the average cycle time of activities executed by staff A and B, it was observed that staff A outperformed staff B in most cases, except for the online-offline order customer service and online-offline customer payment activities. In terms of the overall collaborative work of staff A and B, inefficiency was noted in online order processing, offline customer service, online customer service, online-offline customer order taking, and online-offline customer payment. The cycle time for these activities tended to be higher when staff A and B worked collaboratively compared to when they performed individually.

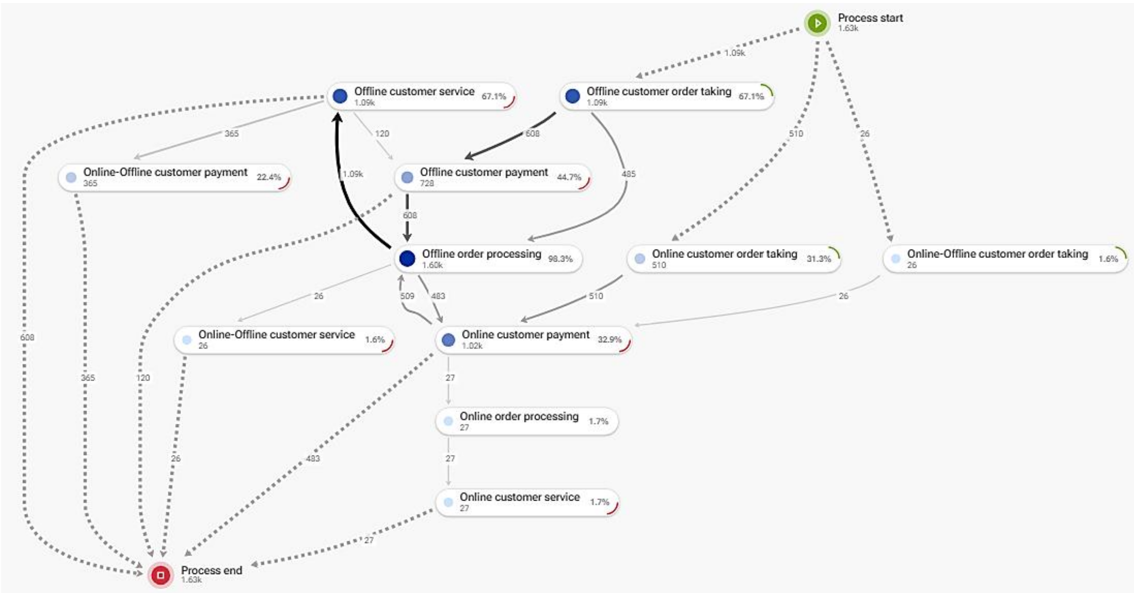

Figure 2 Process extraction

Table 3 Average cycle time of all activities

Key activities	Cycle time (mins)		
	Overall works by Staff A and B	Staff A only	Staff B only
Offline customer taking	**0.2492**	0.2498	0.2691
Online customer taking	-	-	-
Offline order processing	**3.36**	**3.36**	3.37
Online order processing	3.07	**3.04**	3.09
Offline customer service	1.86	**1.85**	1.86
Online customer service	2.33	**2.31**	2.35
Offline customer payment	**1.03**	**1.03**	1.05
Online customer payment	-	-	-
Online-Offline customer order taking	1.31	**1.28**	1.33
Online-Offline customer service	**2.58**	2.60	**2.58**
Online-Offline customer payment	1.91	1.91	**1.90**

Note: Minimum cycle time is highlighted bold.

One of the advantages of process mining is the ability for service managers to include or exclude specific processes, thereby facilitating alternative perspectives on service performance. In this context, the examination of online-offline activities and their association with other activities is crucial. Table 4 demonstrates that the average cycle time, excluding cases involving online-offline interactions, tends to be shorter for offline order customer taking and offline order processing. It can be inferred that online-offline activities generally impose certain limitations on the overall process performance.

It is important to acknowledge that eliminating such online-offline interactions is not a feasible solution. However, it is necessary to redesign bottleneck activities, namely online-offline customer order taking and online-offline customer payment, to enhance the workflow of collaboratively performed activities by staff A and B. Such improvements can lead to enhanced performance in offline order processing and offline customer order taking, which are critical processes within the food and beverage business.

Additionally, analyzing the interaction between staff A and B within the service processes becomes vital to distinguish their respective performance levels across various service channels, including online, offline, and online-offline channels. Figure 3 visually represents the interaction between staff A and B across different service processes and channels.

Table 4 Average cycle time of the activities except cases of online-offline interaction activities

Key activities	Cycle time (mins)		
	Overall works by Staff A and B	Staff A only	Staff B only
Offline customer taking	**0.2093**	**0.2095**	**0.2326**
Online customer taking	-	-	-
Offline order processing	**3.33**	**3.33**	**3.33**
Online order processing	3.07	3.04	3.09
Offline customer service	**1.85**	1.85	1.88
Online customer service	2.33	2.31	2.35
Offline customer payment	1.03	1.03	1.05
Online customer payment	-	-	-

Note: Activities with lower value of cycle time compared to those in Table 3 are highlighted bold.

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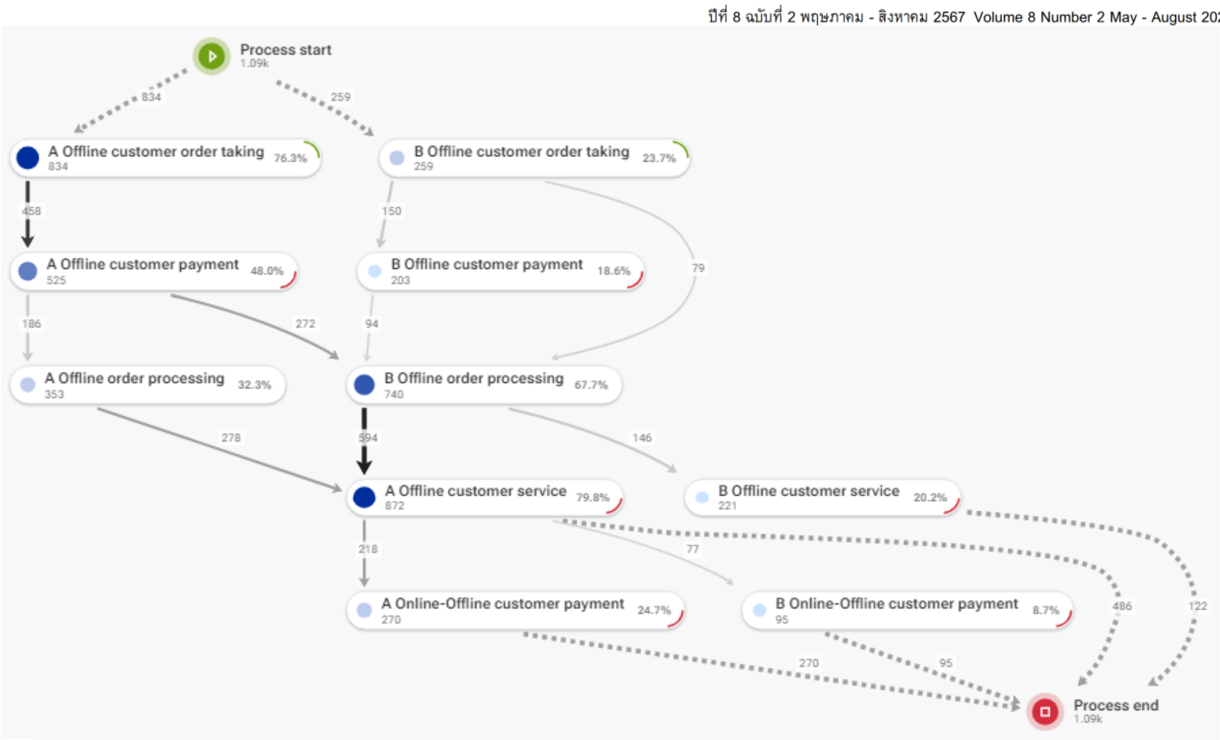

Figure 3 Interaction of work performed by staff A and B

When analyzing service delivery performance, specifically throughput time and sales value associated with each staff member and mapping them to the discovery patterns (refer to Table 5), it becomes evident that staff A handles larger volumes of customer orders compared to staff B in most activities, with exceptions in offline customer order-taking and offline customer payment (Patterns 3, 4, and 5). In the case where both staff members are involved (Pattern 6), the calculated throughput time for the service is 8.64 minutes, obtained by summing up the maximum throughput time for each activity, regardless of the staff member performing it. Comparing the throughput time deviations from other patterns (Patterns 1 to 5), where staff B's involvement in the process is more prominent, it is observed that the deviations are 41.4%, 7.73%, 7.59%, 6.66%, and 0.23% higher, resulting in throughput times of 6.11, 8.02, 8.03, 8.10, and 8.62, respectively. These findings highlight the impact of diverse service channels, particularly when incorporating online-offline channels. Furthermore, when allocating staff members for online-offline activities and other related tasks, careful consideration must be given to workload concerns and staff capabilities, including multitasking aspects.

Due to synchronous customer orders, there is a need to perform tasks in a sequential manner, which requires multitasking capabilities to effectively respond to customer demands. For example, staff A assists with offline order processing when staff B is unable to complete the tasks required for processing subsequent customer orders. This indicates the extent of multitasking required by the staff to fulfill their current responsibilities. In the activity of offline customer order-taking, it is observed that staff A handles a larger number of cases, specifically 353 orders, which is 36.29% higher than the ideal work allocation (Table 6). It is also evident that the current workload of staff A exceeds that of staff B in both offline and online-offline customer payment

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activities. However, staff A demonstrates better performance, characterized by higher throughput, compared to staff B.

It is important to emphasize that designing work processes that incorporate online-offline services necessitates a comprehensive understanding of the connections and interactions among service providers, systems, and customers. Rather than relying solely on overall performance metrics related to critical processes and customer outcomes, the adoption of a process mining approach facilitates an in-depth analysis of all processes involved.

Table 5 Patterns of service flow and throughput time performed by staff A and B

Level	Pattern 1	Pattern 2	Pattern 3	Pattern 4	Pattern 5	Pattern 6
1	$A_{COT-Off}$ (0.2439)	$A_{COT-Off}$ (0.2439)	$A_{COT-Off}$ (0.2439) **$B_{COT-Off}$** **(0.2664)**	$A_{COT-Off}$ (0.2439) $B_{COT-Off}$ (0.2664)	$A_{COT-Off}$ (0.2439) $B_{COT-Off}$ (0.2664)	$A_{COT-Off}$ (0.2439) $B_{COT-Off}$ (0.2664)
2	A_{CP-Off} (0.5954)	A_{CP-Off} (0.5954)	A_{CP-Off} (0.5954)	A_{CP-Off} (0.5954)	A_{CP-Off} (0.5954) **B_{CP-Off}** **(1.12)**	A_{CP-Off} (0.5954) B_{CP-Off} (1.12)
3	B_{OP-Off} (3.44) A_{OP-Off} (3.41)	B_{OP-Off} (3.44) A_{OP-Off} (3.41)	B_{OP-Off} (3.44) A_{OP-Off} (3.41)	B_{OP-Off} (3.44) A_{OP-Off} (3.41)	B_{OP-Off} (3.44) A_{OP-Off} (3.41)	B_{OP-Off} (3.44) A_{OP-Off} (3.41)
4	A_{CS-Off} (1.84)	A_{CS-Off} (1.84)	A_{CS-Off} (1.84)	A_{CS-Off} (1.84) **B_{CS-Off}** **(1.91)**	A_{CS-Off} (1.84) B_{CS-Off} (1.91)	A_{CS-Off} (1.84) B_{CS-Off} (1.91)
5	-	**A_{CP-OO}** **(1.91)**	A_{CP-OO} (1.91)	A_{CP-OO} (1.91)	A_{CP-OO} (1.91)	A_{CP-OO} (1.91) **B_{CP-OO}** **(1.89)**

The findings indicate that design variables concerning the tasks or processes, including the staff responsible for performing them, sales value, and service channels, can be effectively incorporated to inform decisions regarding work design. These variables provide valuable insights for optimizing the integration of online-offline services and the augmented workforce. Based on the results, the next step will involve incorporating these findings to generate practical recommendations for the design of work processes, particularly in the context of online-offline service integration and the utilization of an augmented workforce.

Table 6 Comparison of the number of cases for actual and ideal work

Activity	Number of cases for actual work			Number of cases for ideal work		
	Staff A	Staff B	Total	Staff A	Staff B	Total
Offline customer order taking	834	259	1,093	834	259	1,093
Offline order processing	353 (+36.29%)	740 (-11.27%)	1,093	259	834	1,093
Offline customer service	872 (+4.55%)	221 (-14.67%)	1,093	834	259	1,093
Customer payment	795 (+45.33%)	298 (-45.42%)	1,093	547	546	1,093
Offline customer payment	525 (+44.23%)	203 (-44.23%)	728	364	364	728
Online-offline customer payment	270 (+47.54%)	95 (-47.8%)	365	183	182	365

Discussion

In many service businesses, constraints on workforce utilization often pose significant challenges. During peak demand periods, service staff are typically assigned to a single job to effectively serve customers. However, as illustrated in this case, staff members are required to perform multiple tasks within limited human resources environments. The work operates under constraints related to workforce availability and resource limitations, without the integration of user-system interfaces or the utilization of devices to facilitate smoother staff operations. Consequently, work interaction patterns between service providers and systems exhibit multiple patterns. When such work patterns are not appropriately designated, it can result in inefficiencies in subsequent offline and online activities.

From an operational perspective, the work design should focus on enhancing interactions between staff members and between staff and systems requires an analysis of service processes across various channels. The complexity arising from the interactions and collaborations among service providers, service channels, and service processes should be considered when making decisions regarding online-offline service integration. The process mining results indicate that many offline and online activities still exhibit inefficiencies, as the cycle time for individually performed work is lower compared to collaborative work. There is a need for greater effectiveness in online-offline service integration.

By identifying the workflow encompassing online, offline, and online-offline activities using process mining. It proves instrumental in capturing the complexity of the workflow, enabling the extraction of existing patterns. The analysis results also shed light on the impact of staff workload, service channels, their degree of integration, and staff capabilities on service performance. When designing online-offline service integration, considerations extend beyond mere technological means to bridge the gap between humans and systems. The case study demonstrates the direct and indirect effects of online and offline workflows on the performance of online-offline activities.

Considering the aforementioned points, it is not advisable to address the challenge of improving customer service solely by assigning and allocating additional staff. Similarly, reversing the transition from online to offline services may lead to a decrease in current sales volumes. Therefore, a focused approach is required for the integration of online-offline services. This study emphasizes the importance of work design, human-technology interaction, and the utilization of an augmented workforce in service settings, irrespective of their scale. A proposed work design for enhancing the integration of online-offline services by fostering a higher degree of interaction and implementing an augmented workforce is presented as follows.

Firstly, within the process of taking customer orders, a multitude of devices are being utilized, including Point-of-Sale (POS) machines, mobile phones, and specialized handheld devices from food delivery platforms. It is necessary to develop features that facilitate increased interaction with offline activities, thereby reducing the number of touchpoints between online and offline customers. An example of such a feature is the implementation of a split-screen mode, where one screen is dedicated to handling offline customers and another screen is dedicated to managing online customers. This design approach allows for improved efficiency and seamless coordination between the different customer channels. It is supported by the fact that the integration of POS systems with technologies like mobile devices, the internet of things (IoT), and augmented reality technology (ART) has garnered interest. This integration allows sellers to enhance customer experiences, offering access to a broader array of products and services (Santos & Bacalhau, 2023).

Secondly, in the present setting, the flow and movement of staff require optimization due to the fixed layout of workstations and customer tables. Several alternatives can be considered to address this issue, encompassing various approaches ranging from completely offline solutions (e.g., implementing new layout design solutions to minimize staff movement) to exclusively online solutions (e.g., integrating smart ordering and customer service systems). Another approach involves the introduction of online-offline and offline-online services that promote a higher degree of interaction and collaboration between humans and machines. This can be achieved through the implementation of features such as a streamlined click-and-collect process, interactive messaging channels, and online self-checkout and payment methods. These alternatives aim to enhance operational efficiency, improve customer experience, and optimize the interaction between staff and technology within the service environment. According to the work of Hirsch-Kreinsen and Ittermann (2021), it strongly points out the design and implementation of human-oriented forms of digitized work are crucial to the digitalization of work processes.

Thirdly, in the process of handling online customer orders, there is typically a delay experienced in locating the necessary devices and processing these orders. However, it is crucial to ensure that this procedure does not impede other activities or hinder staff members from promptly responding to customer needs. A more efficient approach would involve enabling staff members to instantly accept and manage customer orders, thereby facilitating faster and more responsive service. This complies with the concept of "smart working" in which technologies free business activity from a focus on place, as work activities have been able to harness information and communication technologies to operate remotely (Angelici & Profeta, 2023). It can be achieved by implementing smart service platforms that support multiple users, enabling work to be carried out more expeditiously, with enhanced engagement, and greater responsiveness to incoming customers. By leveraging such technologies, service providers can streamline their operations, resulting in improved customer experiences and increased operational efficiency.

Fourthly, interaction between online and offline services can be observed in two distinct forms: online-to-offline and offline-to-online interactions. Online-to-offline service interaction occurs when service staff receive phone calls from online customers and make necessary adjustments to orders based on customer requests. Another scenario involves service staff initiating contact with online customers through phone calls or application-based messaging to address issues such as order corrections or cancellations. On the other hand, offline-to-online service interaction occurs when offline customers express the desire to use various payment methods, including cash, cashless payment, or mobile banking transfers, for a specific order, and the staff manage both online and offline payment transactions. The outcomes of the case study further emphasize the importance of handling online activities with due care, particularly when services offer a range of alternative offline channels for customers, and vice versa. It can be supported by a framework for conceptualizing omnichannel integration as a continuum to determine how firms should position along that continuum (Neslin, 2022). Thus, the significance of effectively managing the integration between online and offline service channels to optimize customer experiences and operational efficiency can be highlighted.

Lastly, to enhance online-offline service integration, a key approach is to improve the quality of communication channels among both the staff members themselves and their interactions with customers. One potential strategy for augmenting the workforce is through the implementation of an "unfact" service approach, as proposed by Lee and Lee (2020). This strategy enables customer interactions to occur without direct face-to-face contact with employees, allowing for more efficient online-to-offline and offline-to-online interactions.

Conclusion

This study offers a comprehensive analysis and a deeper understanding of how work design for online-offline service integration can be justified and facilitated using a process mining approach. Given the complex nature of service processes and the enhanced level of interaction and collaboration between humans and machines along the service journey, process mining proves valuable in uncovering work patterns as well as forms of human-machine interaction and collaboration. The results of this study show that the service flows of food and beverage business under online-offline activities must be optimized. It is typically that the works are added up directly to the processes without considering such issues as unneeded work interaction, workload balancing, and efficiency of human-machine works. This leads to inefficient services and less service integration. Key principles of the work design for online-offline service integration are to focus on human-oriented forms of digitized work while enhancing omnichannel integration of the service. When designing and implementing the improved interaction and collaboration, it is crucial to investigate the work interaction and collaboration among service staff and machines within offline, online, and online-offline activities and measure the service performance accordingly. The findings derived from this analysis yield clearer insights into how work should be designed to enhance service performance while considering factors such as staff workload, service channels, their integration level, and staff capability. Importantly, this study demonstrates that process mining effectively addresses the complexity and informality inherent in service processes, allowing for an examination of service performance metrics, namely cycle time and throughput time, in relation to the varied patterns of service delivery and interaction. Moreover, there is a viable opportunity to enhance the process discovery by incorporating additional data sources. This study recognizes the online-offline interaction by incorporating surveillance and sales data. The future research works can be conducted by exploring other data related to process behavior and control-flow, such as device touchpoints, product types, customer sources, and ordering channels, which would provide additional insights and benefits.

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