

Self-Service Technologies: An AI-Powered Transformation

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Abstract

This study has gone through extensive literature search exploring the development and impact of self-service technologies (SSTs), with a particular focus on the transformative potential of Artificial Intelligence (AI) in shaping the future of self-service. As digital transformation reshapes the marketing landscape, companies are increasingly adopting SSTs to meet customer demands for convenience, speed, and personalization. The study traces the development of SSTs from their early forms, such as vending machines and ATMs, to advanced AI-powered systems that offer real-time, personalized service. It also highlights the benefits of self-service for both businesses and customers. Furthermore, the involvement of customer with self service technologies and the factors that influence customer adoption of these technologies are observed. It then explores the role of AI in revolutionizing self-service. AI-based SSTs offer significant advantages over traditional systems, including improved accuracy, efficiency, and a seamless user experience. It is also acknowledged that while AI-powered SSTs are designed for self-service, human interaction remains valuable. This study provides a comprehensive conceptual framework on self-service technologies and AI integration.

Introduction

As Akyüz (2023) indicate, the digital age has dramatically reshaped the marketing landscape. To stay competitive, marketers must strategically integrate technology into their business models. This involves rethinking product offerings and customer interactions in a digital context. Digital transformation in marketing is essentially the process of optimizing online platforms and incorporating digital tools to achieve marketing goals.

Web 3.0, characterized by decentralization, blockchain, and the increasing integration of AI, paves the way for Web 4.0, where AI takes center stage. By integrating AI, Web 4.0 empowers self-service technologies to understand and respond to user needs in real-time. AI-driven chatbots and virtual assistants become intelligent companions, providing personalized experiences and automating tasks. Decentralized data management ensures privacy while AI algorithms derive insights to refine services. Modern customers crave convenience, speed, and experiences tailored to their needs. Businesses are responding by embracing self-service technologies. Self-service technology empowers customers to handle tasks independently, without needing direct human assistance. By shifting routine transactions to self-service, businesses free up resources to focus on higher-level services and create a more satisfying customer experience. By offering tools like chatbots and IVR systems, businesses can streamline operations and gather immediate customer feedback. This approach benefits customers by providing convenience, control, and a sense of independence. To succeed in the future, companies must prioritize customer needs when designing self-service options, aim to resolve issues quickly without human intervention, and find the right balance between automated and live support.

This paper explores the development of self-service technologies, their impact on businesses and customers, and the transformative potential of AI in shaping the future of self-service.

Self-Service Technology

A Self-Service Technology (SST) (Sohn et al., 2024), is a combination of software and hardware that empowers customers to independently create and use services. The software guides users through the process, offering necessary tools, while the hardware provides access to this software. Traditionally, businesses owned the hardware

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used for SSTs, but the rise of internet-connected personal devices has allowed customers to utilize their own gadgets (like smartphones) to participate in services previously handled by company-owned equipment. According to Meuter et al. (2000), Self-Service Technology is a technological platform that empowers consumers to independently complete service tasks without direct employee assistance. Essentially, SSTs act as intermediaries that enable customers to handle services on their own. Anselmsson (2001) defines self-service technology as technological tools provided by businesses to allow customers to independently perform all or part of a service. In other words, SST empowers customers to take ownership of the service process.

Self-service technologies encompass a wide range of automated systems. Examples include ATMs, supermarket self-checkouts, gas pumps, automated phone services like banking or hotel check-out, train ticket machines, and various online or app-based platforms. Information-based services are ideally suited for self-service technologies. These services encompass a wide range of activities, from basic tasks like obtaining information, ordering goods, and making reservations to core functions in sectors like online learning and research (Wirtz and Lovelock, 2016). Meuter et al. (2000) suggest that SSTs can be evaluated based on factors such as ease of use, efficiency, time-saving, and the degree of control offered to the consumer.

Malcom (2024) reports that the 20th century's technological advancements significantly accelerated the growth of self-service. One of the pioneering examples is the vending machine, which eliminated the need for cashiers. Introduced in the late 19th century, these machines gained immense popularity throughout the following century due to their convenience and 24/7 accessibility. Another milestone in self-service was the supermarket concept pioneered by Clarence Saunders with Piggly Wiggly. This revolutionary approach transformed retail by empowering customers to independently explore and choose products. As a result, self-service became a standard practice in retail stores. The second half of the 20th century marked the digital age of self-service. The ATM revolutionized banking by allowing customers to handle transactions independently. Subsequently as indicated in the article published in Malcom, self-checkout systems transformed retail, offering customers greater control over the shopping process. The advent of smartphones further accelerated this trend. Mobile apps provided a convenient platform for various self-service options, from banking to shopping. QR codes and mobile payments streamlined transactions. Artificial intelligence has significantly enhanced self-service capabilities. Virtual assistants and chatbots offer round-the-clock support, while AI-powered personal shopping services deliver tailored recommendations based on individual preferences. These advancements represent a substantial leap forward from the early days of self-service (Malcom, 2024).

As indicated by Fitzsimmons and Fitzsimmons, (2011), a typical business trip highlights numerous opportunities for self-service. For service providers, the main incentive is the reduction of labor costs associated with nonproductive tasks. Customers, on the other hand, often embrace and even prefer self-service due to the increased potential for customization, accuracy, convenience, and speed. Fitzsimmons and Fitzsimmons state that, services have shifted from human interactions to the use of machines in place of service employees, and whenever possible, to electronic services that are accessible anytime, anywhere. Here are some examples of the progress that self-service technologies have made over time; in the restaurant sector: waiter (human contact) - vending machines (machine assisted) - online order and delivery (internet facilitated); in the education sector: teacher (human contact) - computer tutorial (machine assisted) - distance learning (internet facilitated). The first focus of self-service technologies was on service transactions that offered little value or revenue growth potential, as replacing employee labor with technology led to cost reductions. For instance, banks introduced ATMs over 25 years ago to cut teller costs while also offering customers the convenience of accessing services at any time and location (Fitzsimmons and Fitzsimmons, 2011).

Self-service technologies enhance service quality by simplifying tasks for customers. These technologies save customers time and effort. Ultimately, they can lead to improved customer satisfaction, increased independence for both customers and employees, and greater operational efficiency (Amin et al., 2019). Businesses invest in self-service technology to reduce costs and improve service quality. By automating routine tasks, companies can reallocate employees to more valuable roles or reduce workforce size. This technology allows employees to focus on complex tasks. Ultimately, customers benefit from increased efficiency, convenience, and service quality. Additionally, self-service technology enables businesses to standardize customer experiences and implement targeted sales strategies (Castro et al., 2010). As Amin et al. (2019) mention, organizations adopt self-service technologies for various strategic reasons. These include meeting customer expectations, reducing operational costs, enhancing service quality, increasing customer satisfaction, expanding service delivery channels to reach new and existing customers, and gaining a competitive edge. Bitner (2001) advises managers to evaluate their firms' self-service technologies by considering three key questions: "Does the SST work reliably?" It's crucial that SSTs perform as expected and are user-friendly. "Is the SST better than the interpersonal alternative?" "If the SST doesn't offer advantages like saving time, improving accessibility, reducing costs, or delivering other benefits, customers may stick with traditional face-to-face interactions. "If it fails, what systems are in place to

recover?" It's essential for firms to have robust recovery mechanisms to quickly address issues when SSTs malfunction.

Self Service Technologies And Automation

While self-service and automation both aim to streamline processes, they are distinct concepts. Automation involves replacing human tasks with technology, such as using barcode scanners to eliminate manual price entry. Self-service, on the other hand, transfers service responsibilities from employees to customers, like self-pumping gas instead of using an attendant. The contrast between self-service gas stations and automated car washes illustrates this difference (Castro et al, 2010).

According to Fitzsimmons and Fitzsimmons (2011), classifying automation applications in services requires a broader approach than the traditional methods used in manufacturing, due to the potential for customer interaction. David Collier (1983), proposed categories of automation:

1. **Fixed Sequence (F):** This refers to a machine that repetitively executes a series of steps in a specific operation according to a set sequence, conditions, and positions. The information programmed into the machine cannot be easily altered. *Example in service:* an automatic parking lot gate.
2. **Variable Sequence (V):** Similar to a fixed-sequence robot, but with easily changeable information settings. *Example in service:* an automated teller machine
3. **Playback (P):** A machine capable of reproducing operations from memory that were initially performed under human control. *Example in service:* a telephone answering machine.
4. **Numerical Controlled (N):** A machine that performs tasks according to a sequence, conditions, and positions as directed by stored instructions that can be easily reprogrammed. *Example in service:* animated characters at an amusement park.
5. **Intelligent (I):** A machine equipped with sensory devices, such as visual or tactile receptors, that can detect changes in its environment or task independently and make decisions on its own. *Example in service:* an autopilot system for a commercial airplane.
6. **Expert System (E):** A computer program that utilizes an inference engine (i.e., decision rules) and a knowledge base (i.e., subject-specific information) to diagnose problems. *Example in service:* maintenance troubleshooting for elevator repair.
7. **Totally Automated System (T):** A system comprising machines and computers that handle all physical and intellectual tasks required to produce a product or deliver a service. *Example in service:* electronic funds transfer (Collier, 1983).

Fitzsimmons and Fitzsimmons (2011) states that, with the rise of automation, services are becoming increasingly capital-intensive, challenging the outdated view of the service sector as low-skilled and labor-intensive. Service workers will now require advanced skills to program, operate, and maintain automated systems. Additionally, employee flexibility will become highly valued, as new technologies significantly alter the nature of work. For instance, the introduction of personal computers and word-processing tools has brought about many changes in the office environment.

Customer Involvement With Self-Service Technologies

While technology has significantly boosted productivity for both administrative and customer-facing staff across industries, there's still substantial potential to optimize service delivery by involving customers in the process (Castro et al, 2010). Wirtz et al. remark that it is crucial for service marketers to understand how consumers choose between using SSTs and interacting with a human provider. From the customer's perspective, Self-service technologies offer both benefits and drawbacks. The advantages include increased convenience, such as saving time, faster service, and the flexibility of accessing services anytime (e.g., 24/7 availability) and anywhere (e.g., widespread ATMs). SSTs also provide cost savings, greater control over service delivery, and a higher perceived level of customization. Additionally, customers may find SSTs enjoyable, sometimes experiencing fun (Wirtz et al., 2012). Customers play an active role in creating the value of a product or service when using self-service channels (Vargo and Lusch, 2008). Unlike self-service options, personal service channels require direct interaction between customers and service providers. These channels, often called "assisted channels," involve employees actively helping customers throughout the service process (Kumar and Telang 2012).

Wirtz et al. (2012) state that, individuals who possess greater confidence and knowledge about a service or channel are more inclined to utilize impersonal and self-service options. Then again, customers who prioritize the functional aspects of a transaction typically seek convenience, often leading them to choose self-service channels. Conversely, those with social motives are more likely to prefer personal interactions in their service

experiences. As Grönroos (2015) notes, enhancing productivity and quality involves considering the impact of customers on the service process. This can be done in two main ways. First, by incorporating more self-service options. However, it is crucial that this is not driven solely by a desire to increase internal efficiency. Customers must perceive clear benefits from engaging in self-service; otherwise, the perceived quality may decline. To encourage participation, customers need to be rewarded and motivated to use self-service features. The second method for improving productivity and quality through customer involvement is by enhancing customers' participation skills. Often, customers may not fully understand what is expected of them. This can negatively affect both the functional and technical quality of the service. Also might require more employee time to guide customers through the process, thus reducing productivity (Grönroos, 2015).

Wirtz et al (2012) suggest that, besides the advantages, customers often become frustrated with self-service technologies when they fail, whether it's due to PIN numbers being rejected, websites crashing, or tracking numbers not working. Even when SSTs function correctly, poorly designed interfaces that complicate the service process can still lead to dissatisfaction. It's common for users to express frustration over navigating confusing websites. Despite the potential benefits of SSTs, not everyone uses them. According to Meuter et al (2005), many companies struggle to encourage customers to adopt these technologies rather than facing difficulties with the technology itself.

Matic and Prskalo (2016) investigated consumer receptiveness to new self-service technologies in retail. Their findings suggest that consumers are generally open to these technologies and have a fairly high level of trust in innovative options like smart shopping carts. Furthermore, the study indicates a positive consumer attitude toward such advancements and a strong intention to use them for future shopping trips. Research by Curran and Meuter (2007) explored why consumers choose self-service technology over human interaction. Surprisingly, enjoyment was a more significant factor than perceived usefulness, even in a typically mundane sector like banking. While enjoyment is crucial in retail SST adoption, other studies have focused on perceived control. Dabholkar (1996) linked perceived control to service quality and the intention to use SST. Marzocchi and Zammit (2006) supported this, finding a positive correlation between perceived control and perceived service quality. Robertson et al. (2016) further emphasized the strong link between perceived control and SST satisfaction. Anselmsson (2001) found that a customer's desire for independence is the primary factor influencing their perception of service quality when using self-service technology. Anselmsson also came to the conclusion that the mere presence of staff, even if they are not actively assisting customers, positively impacts customers' perception of service quality when using self-service technology. Nilsson et al. (2021)' s research showed that usability, ease of use, pleasure, reliability, and support have a significant positive relation with both attitude toward self-service technologies and satisfaction with it. On the other hand it is found that, need for interaction with staff and lack of personal service has a significant negative relation with both attitude and satisfaction. Kasavana's 2008 research found that customers who previously faced issues like long wait times or service delays are now more inclined to use advanced technologies, such as self-service systems, to interact with businesses. And in Hakim et al.'s (2022) research it is indicated that, while the effectiveness, ease of use, and interactive nature of self-service technology are key factors driving its adoption, user intention is also crucial.

Artificial Intelligence Based Self-Service Technology

The Web 3.0 era, which began in the 2010s and continues today, is defined as the “semantic web” in which machine learning is developed through advanced algorithms and databases that communicate with each other, and in which internet control is no longer controlled by humans and data is classified using artificial intelligence technology (Korkmaz, 2023). Akyüz and Mavnacıoğlu (2021), note that AI, through machine learning, efficiently identifies crucial data for businesses. It assists digital marketers by automating tasks, analyzing data, personalizing campaigns, and enhancing user experiences. As AI continues to refine its understanding of customers, marketers can expect to engage audiences in innovative ways, gain deeper insights into consumer behavior, and deliver highly personalized offers in real-time. Ostrom et al. (2019) categorized AI's role in service interactions into three types. In AI-supported encounters, humans handle customer interactions while AI assists behind the scenes. AI-augmented encounters involve AI directly interacting with customers or aiding human staff, enhancing the service. AI-performed encounters replace humans entirely, with AI handling the entire customer interaction. Pillai et al. (2020) outline that advanced technologies like robots, chatbots, virtual and augmented reality, and machine learning are transforming both online and physical stores. AI-powered automated retail stores (AIPARS) combine these technologies to create self-service shops that can handle everything from customer service and sales to payment and delivery without human intervention. These stores offer features such as one-click checkout, personalized product information, and automated customer support.

Huang and Rust (2018) propose a four-step evolution of AI. First is mechanical intelligence, which reacts to surroundings based on given rules using sensors and stored information. Next is analytical intelligence, capable

of problem-solving and learning from data. Following this is intuitive intelligence, applying experience to creatively solve new problems. Lastly, empathetic intelligence understands human emotions and responds accordingly, fostering collaboration. Later on, Huang and Rust developed a strategic framework in 2021 for using AI to improve customer interactions and service outcomes. This framework categorizes AI into three levels: mechanical, thinking, and feeling. The type of AI best suited for a service depends on the service's nature, goals, and process. As AI becomes more advanced, the need for human involvement in simpler tasks will diminish. Currently, mechanical AI is ideal for routine services, thinking AI excels at personalized services in data-driven environments, and feeling AI is best for building customer relationships.

While self-service technologies (SSTs) are widely used across industries, the integration of AI is a recent development. AI-powered SSTs offer advanced capabilities compared to traditional systems. They incorporate features like natural language processing, facial recognition, and machine learning to provide 24/7 self-service options. Additionally, these systems can analyze and utilize data from past transactions to improve performance (Rijsdijk et al, 2007). AI-based SSTs continually improve through learning from customer interactions. As more transactions are processed, the system's recommendation accuracy increases. This leads to highly personalized, efficient, and satisfying user experiences (Chen et al., 2021). Besides, AI-powered self-service technologies can deliver more reliable, faster, and tailored services due to their advanced data management, rapid processing, and precise personalization features (West et al., 2018). In their study, Xu et al (2020) compared how customers felt about using AI versus human customer service. They found that people think AI is better at handling simple problems and prefer using AI for these types of issues. However, for complex problems, people believe humans are more capable and are more likely to choose human customer service.

Chen et al. (2021) state that AI-based SSTs offer distinct advantages over traditional self-service technologies. In the space attribute, Conventional SST is physical while AI based SST is bridging physical and digital. While the core technology of Conventional SST is "button", those of AI-based SST are "natural language processing, face recognition, recommendation algorithm". While the nature of interactivity attribute is "user to machine" for Conventional SST; in AI-based SST, it includes "user to machine, machine to machine, user to user to government officials". The nature of the experience is offline in Conventional SST, but on the other hand, a personalized and seamless user experience is offered in AI-based SST. Finally, while the service provision attribute is fixed service for Conventional SST, it is always on / always responsive service in AI-based SST (Chen et al., 2021).

While AI-powered SSTs are designed for self-service, human interaction remains crucial. Turkson et al (2024) point out that, a hybrid model combining automated service with human support offers the best of both worlds. When customers encounter issues or require assistance, knowledgeable staff can step in to provide personalized help. In an SST environment, interpersonal communication plays a key role in building confidence and trust. Customers from Generations X, Y, and Z may feel reassured knowing a human support system is in place, ready to assist when needed. This sense of security can improve the overall customer experience and encourage continued use of SSTs (Turkson et al, 2024).

As Xu et al. (2020) suggest, by leveraging natural language processing, chatbots can analyze customer inquiries for key terms and generate relevant, coherent responses based on extensive databases. Through deep learning, these AI systems continually enhance their ability to respond accurately and expand their knowledge base with each interaction. Ferraro et al. (2024) state that, Generative AI chatbots can swiftly guide customers to self-service solutions without requiring human assistance. They are skilled at recognizing and resolving customer problems through questioning and analysis, leading to quicker solutions and happier customers. This reduces reliance on human support staff. These chatbots create a natural, conversational self-service experience. However, while they can improve service efficiency, GenAI chatbots often struggle to show empathy. Unlike humans who can understand nuances and offer tailored responses, chatbots typically provide generic, automated answers (Ferraro et al., 2024). Van den Berg and Fan (2023) add that AI has been used in customer service for some time, primarily through chatbots powered by Conversational AI. These chatbots follow specific rules to provide accurate answers. While reliable, they lack the flexibility of Generative AI. Generative AI can create more human-like interactions by understanding context and generating unique responses. However, it's prone to errors, can produce inappropriate content, and raises legal concerns about copyright infringement.

As AI-powered customer service can enhance service quality, research suggests that AI chatbots may fall short in providing the same level of empathy as human agents (Castillo et al, 2021). Companies can invest in training programs to equip employees with the skills needed for the AI-driven workforce. This includes creating entirely new AI-focused roles and transforming existing positions. For example, customer service agents could be retrained to handle more complex issues requiring human problem-solving and creativity, while AI handles routine tasks (Ferraro, 2024).

AI can significantly improve customer service by quickly identifying and resolving problems, managing customer wait times, and promptly addressing complaints. By effectively using AI, businesses can boost customer satisfaction, loyalty, and retention. AI can create a better customer experience by offering personalized and predictive services. To achieve this, AI tools should be easy to use and understand. Companies must also provide excellent support for customers who need help with AI-powered products or services. Continuous improvement of AI technology is essential to maintain high-quality products and services (Hariguna and Ruangkanjanases, 2024). According to Chen et al. (2021), AI-based self-service technologies incorporate predefined business processes to minimize human intervention, enhancing accuracy and fairness. These systems improve transparency and efficiency by providing citizens with timely, personalized information and services. While AI is a versatile tool for service innovation, most research focuses on information systems (IS) within the private sector. Optimizing IS can stabilize systems, improve user experience, reduce hardware costs, and enhance overall system management.

Conclusion

The integration of self-service technologies has undeniably transformed the service landscape. By empowering customers to take control of service processes, businesses have realized increased efficiency and cost reductions. The evolution of SSTs, from simple vending machines to complex AI-driven systems, underscores the dynamic nature of this field. As technology continues to advance, the potential for further innovation and improvement in SSTs is immense. As the world transition from Web 3.0 to Web 4.0, AI's role becomes increasingly central, transforming traditional self-service models into more sophisticated, personalized, and efficient systems.

However, the successful implementation of SSTs requires a delicate balance between technology and human interaction. While AI offers significant advantages in terms of automation and personalization, it is essential to recognize the limitations of artificial intelligence. A hybrid approach that combines the strengths of both human and machine intelligence is likely to yield the most optimal results. By carefully considering customer preferences, technological capabilities, and business objectives, organizations can develop SST strategies that create value for both customers and the business. Maintaining customer trust and satisfaction requires careful consideration of when and how to integrate AI into service delivery, ensuring that the human element remains central in scenarios where empathy and complex problem-solving are essential.

Looking ahead, the future of self-service technologies will likely be characterized by further integration of AI capabilities, leading to even more sophisticated and intuitive systems. The potential for AI to continuously learn and adapt to individual customer preferences opens up new possibilities for creating highly personalized and seamless experiences. As businesses continue to adopt AI-based self-service technologies, they must prioritize user experience, transparency, and ethical considerations.

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