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DRIVE-THRU TRANSFORMATION: ELEVATING CUSTOMER SATISFACTION WITH DIGITAL TWINS

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ABSTRACT

In the modern business landscape, traditional methods of understanding consumer behavior are constrained by time, cost, and depth limitations. The emergence of Digital Twins, which are virtual replicas created through real-time data integration and advanced algorithms, has fundamentally transformed how we perceive consumer behavior and market responses. This study aims to address challenges related to data security and privacy, exploring potential solutions within the context of applying Digital Twins in drive-thru services. Using a quantitative approach with a sample size of 2000 American drive-thru service customers, the research employs SEM-PLS for data analysis. Online questionnaires are distributed through Triaba to collect targeted data. The findings indicate that while process efficiency in drive-thru services has little impact on service quality, Digital Twins can still lead to waiting times that challenge customer expectations. Although limited to America, this research confirms the significant role of Digital Twins in enhancing drive-thru service efficiency and customer satisfaction, providing valuable insights for users and system integrators during implementation.

Keywords: Digital Twins; Drive-thru; Innovation; Consumer Insights.

INTRODUCTION

As time goes by, business dynamics continue to change and coincide with technological developments. To achieve success, of course, consumer insight through customer responsiveness is needed. BExisting businesses tend to rely on traditional methods of gathering consumer insights. Telephone survey techniques, face-to-face interviews, and focus groups have long been the gold standard. Although these methods provide valuable insights, they have limitations such as taking a long time, being quite expensive, and lacking depth and breadth in understanding the modern consumer. PresenceDigital Twins, confronts us with a virtual replica created by combining real-time data with sophisticated algorithms(VanDerHorn & Mahadevan, 2021). Relevant to consumer insight,Digital Twins become a virtual representation of consumers, reflecting their behavior, preferences and purchasing patterns. This technology is not just a new tool for marketers; rather, it will redefine the entire consumer research landscape.

In contrast to traditional research methods that involve months-long waiting periods,Digital Twins are able to provide insights almost instantly, enabling businesses to respond to market changes at unprecedented speed. Not only in the business realm, so far Digital Twins has been implemented in disaster mitigation in the transportation sector (see Figure 1).

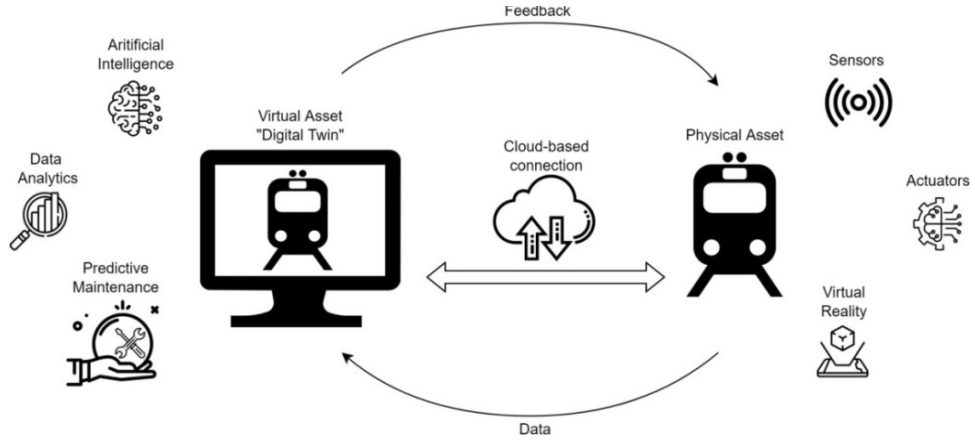

Figure 1. Implementation of Digital Twins in disaster mitigation
Source:(Patandianan & Assidiq, 2022)

Comprehensive data analysis is an advantageDigital Twins, which can integrate multiple data points, from geolocation to online browsing habits, providing a multi-dimensional view of consumers(Lizar et al., 2023). For businesses with global operations,Digital Twins being a game changer created to represent consumers from different regions, ensuring insights that are culturally relevant and geographically specific(Hu et al., 2021). Traditional telephone surveys may capture feedback rate by rate from 50.000 consumers during a month. Vice versa,Digital Twins is able to simulate feedback from 30,000 virtual consumers in one day. Focus group sessions, which may cost as much as $6,000 per session, can be replaced by virtual product testing withDigital Twins, resulting in potential savings of up to 80%. AbilityDigital Twins to simulate various market scenarios can reduce the product testing phase from several months to just a few days. With the ability to integrate real-time data,Digital Twins can predict consumer behavior with an accuracy rate of up to 90%, experiencing a significant jump from the 60-70% accuracy rate in traditional methods(Attaran & Celik, 2023).

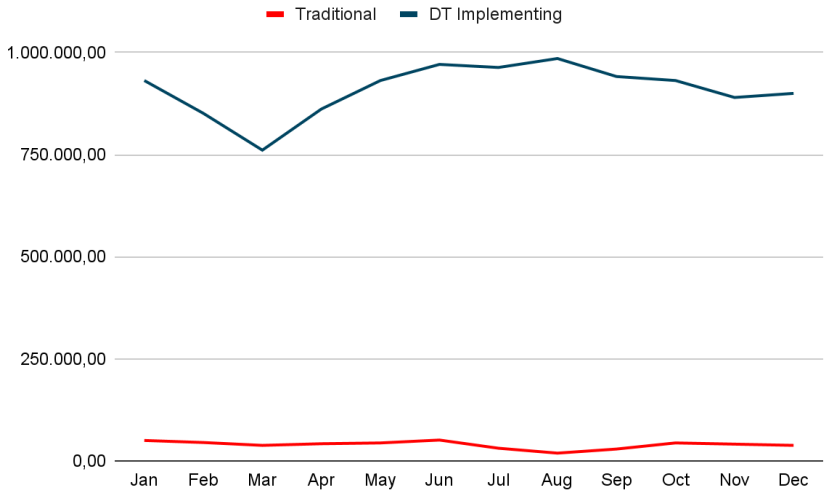

Figure 2. Performance comparison in traditional survey and DT implementation
Source:(Jones et al., 2020)

Digital Twins and its significant impact in various sectors, including banking, business and financial services, has provided a clear example of its implementation. However, so far there

are still challenges and opportunities that need to be explored. Digital Twins in the banking, business and financial services sectors have demonstrated huge potential value in understanding customer behavior, improving security and providing deep insights into business risks(Heluany & Gkioulos, 2023). However, along with the success of technologyDigital Twins In this sector, there are several aspects that need further attention. In this context, technology implementationDigital Twins in the drive thru based service sector, such as at the drive thru services, becomes an interesting research topic. Drive thru is an innovative form of service that can provide convenience and comfort to customers in carrying out transactions.

Digital Twins are very useful in helping various sectors. Research byHuman et al., (2023) has revealed how Digital Twins can work in the consumer goods sector based on a reference architecture. The results enable systematic decisions that reflect complex systems. Apart from that, the results of other research also show that the implementation of integrated procurement, production and distribution (PPD) has provided great benefits. Specifically, the study observed a 65% utilization of pasteurization and aging containers and an impressive 97% utilization of freezers. In addition, by implementing the DT model, the currently implemented model has resulted in a reduction in storage space capacity of 6%, which further simplifies operations and increases efficiency(Maheshwari et al., 2023). Deeper,Wu et al., (2023) His research also shows that Digital Twins have proven effective in managing staff safety, operational information, product quality assurance, as well as maintaining stakeholder loyalty showing a real improvement in the Service Platform for Cold Chain Logistics.Han et al., (2023) The study shows that digital twinning methods enable real-time and continuous control of related operational tasks, and further encourage the development of digitalization, automation and intelligence in hospital operations.

Figure 3. Concept of using Digital Twins in various sectors
Source:(Stavropoulos & Mourtzis, 2022)

This research aims to understand how technologyDigital Twins can be implemented effectively in improving efficiency, performance and user experience of drive-thru services from a consumer perspective. Besides that,benefit from study this is intended to evaluate the impact of useDigital Twins on operational management, customer interactions, and other relevant aspects of the drive-thru environment.Challenges related to data security and privacy, coordinating responses to change, and adapting to different scenarios will also be explored in this research. Thus, this research will not only contribute to understanding the conceptDigital Twins in the context of drive thru services, but also details potential problems and solutions in its implementation. By bringing together an understanding of the success of technologyDigital Twins in related sectors and focuses on drive thru implementation, this research aims to provide a holistic view of the potential benefits and challenges that can be faced in achieving optimal customer satisfaction.

RESEARCH METHODOLOGY

This research adopts a quantitative approach to investigate in depth consumer satisfaction with

the application of technologyDigital Twins Pada drive thru(Esteban-Bravo & Vidal-Sanz, 2021). The research population consists of experienced consumers using the service drive through the United States. This was chosen because the drive-thru system implemented was quite implementable, not only in the fast food sector, but also in other buying and selling sectors where a drive thru system is possible. A sample of 2000 respondents will be selected using the purposive sampling method(Gregori, 2023). The sample criteria taken were individuals who had used the drive thru service at least once.The study was conducted from July to November 2023, a period considered sufficient to collect representative data and examine potential changes over time. The main instrument of this research is an online survey using an interval scale of 1-10(Saris, 2021). This survey is designed to cover important aspects related to consumer satisfaction, perception of effectivenessDigital Twins, and preference for drive thru service (See Table 1).

Table 1. Variable Distribution

Variable	Indicator	
X1 (Accuration of Buying)	X1.1	Accuracy of Product Information
	X1.2	Precision in Order Processing
	X1.3	Correctness of Transaction Amount
	X1.4	Accuracy in Delivery Time
X2 (Interactivity)	X2.1	Responsiveness of Customer Support
	X2.2	Ease of Navigation in the Interface
	X2.3	Availability of Real-time Assistance
M1 (Consumer Experience)	M1.3	Satisfaction with User Interface
	M1.2	Enjoyment in Navigating the Platform
	M1.3	Overall Pleasure in the Shopping Experience
M2 (Process Efficiency)	M2.1	Timeliness in Order Processing
	M2.2	Efficiency in Payment Procedures
	M2.3	Speed of Conflict Resolution
C1 (Service Performance)	C1.1	Timeliness in Service Delivery
	C1.2	Accuracy in Order Fulfillment
	C1.3	Effectiveness in Handling Customer Inquiries
C2 (Security)	C2.1	Data Privacy Assurance
	C2.2	Secure Payment Transactions
	C2.3	Protection Against Unauthorized Access
C3 (Service Quality)	C3.1	Quality of Product Offerings
	C3.2	Reliability of Service Availability
	C3.3	Consistency in Service Standards

Y1 (Consumer Satisfaction)	Y1.1	Overall Satisfaction with the Service
	Y1.2	Willingness to Recommend to Others
	Y1.3	Likelihood of Repeat Purchase

Source: Author's Elaboration, 2023

Distribution of questionnaires was carried out through the Triaba survey service(Triaba, 2022) because it can help get respondents who match the research target. The ethical aspects of research will be maintained in accordance with the applicable research code of ethics, including data security and respondent privacy. Participation in this research is voluntary, and data will be processed anonymously to maintain the confidentiality of respondents' identities(Poth, 2021). Data analysis will be carried out using the SEM-PLS method with the support of SmartPLS 4.0 software, this method will be used to evaluate the relationship between research variables, allowing a deeper understanding of the impact of Digital Twins technology on consumer satisfaction in the context of drive thru services.

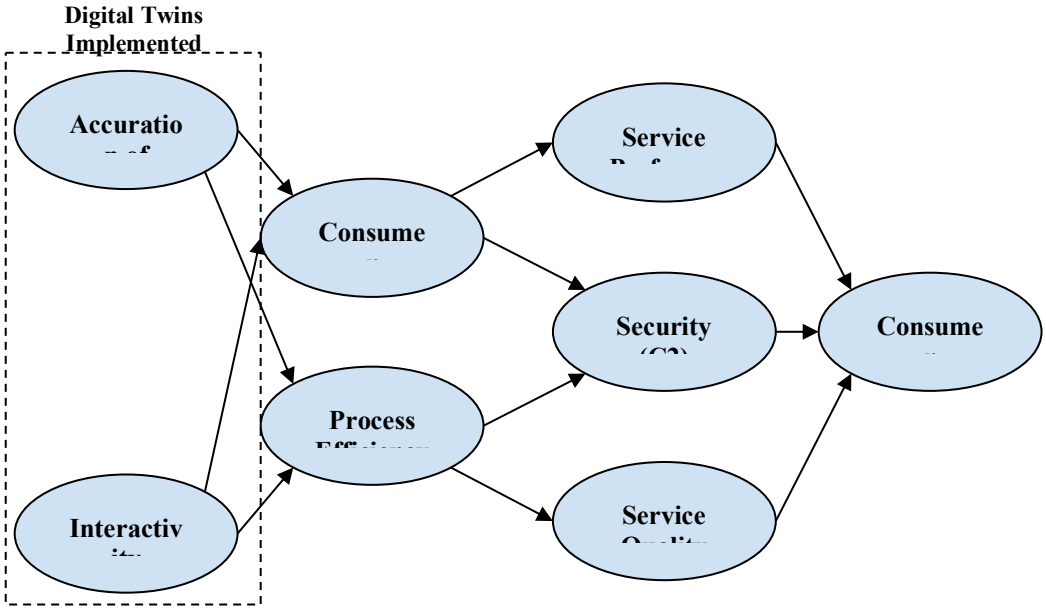

Figure 4. Research Conceptual Framework
Source: Author's Elaboration, 2023

RESULTS AND DISCUSSION

Respondent Profile

Table 2. Respondent Profile

Cluster	Type	Amount	Present
Sex	Male	1137	56,85%
	Female	863	43,15%
Age Group	<22 Years	98	4,90%
	22 - 35 Years	977	48,85%
	35 - 42 Years	812	40,60%

	>42 Years	113	5,65%
Service Type	Fast Food	704	35,20%
	Retail Products	210	10,50%
	Funeral Home	107	5,35%
	Voting	102	5,10%
	Emergency	215	10,75%
	Prayer Room	227	11,35%
	Wedding	116	5,80%
	Law Firm	203	10,15%
	Bar/Club	111	5,55%
	Politician	5	0,25%
Frequency	1 - 2	127	6,35%
	3 - 5	1303	65,15%
	>5	570	28,50%

Source: Author's Elaboration, 2023

Table 2 contains the Respondent Profile which is the focus of this research. Data is grouped into several clusters, including variables such as gender, age group, type of service used, and frequency of use of Digital Twins services. Respondents in this study consisted of 1137 male individuals, which accounted for 56.85% of the total respondents, and 863 female individuals, which accounted for 43.15%. In terms of age group, the majority of respondents were in the 22-35 year age range (977 individuals or 48.85%), followed by the 35-42 year age group (812 individuals or 40.60%). The age groups less than 22 years and more than 42 years contributed 4.90% and 5.65% respectively. The types of services used by respondents in this study cover various categories, with "Fast Food" services dominating (704 individuals or 35.20%), followed by "Prayer Rooms" (227 individuals or 11.35%) and "Retail Products" (210 individuals or 10.50%). This table provides a rich data foundation for analyzing user preferences and habits related to the implementation of Digital Twins in various drive thru services.

Model Evaluation

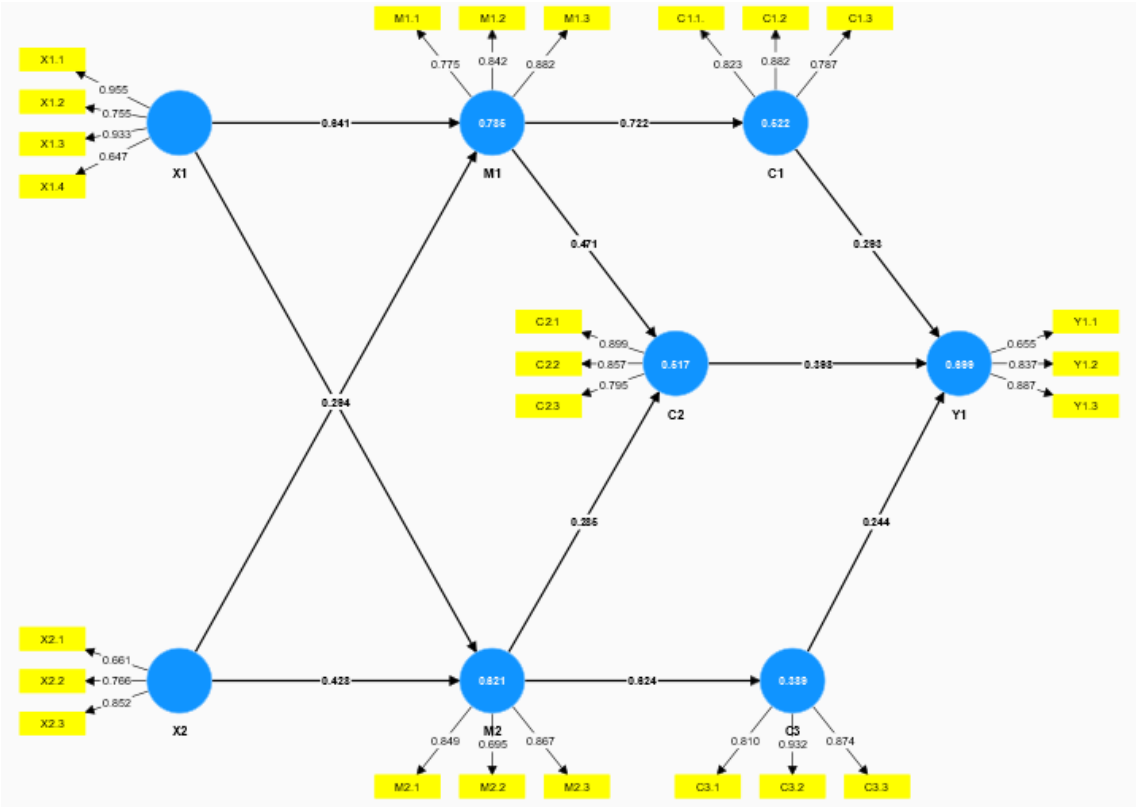

Figure 5. Pathway Analysis Results
Source: Author's Elaboration, 2023

This research tests the reliability of the internal model by applying the convergent validity test. Convergent validity is evaluated through consideration of the Convergent Validity Test value, where the Minimum Average Variance Extracted (AVE) value is expected to exceed the threshold of 0.5. In addition, reliability testing is carried out by paying attention to the Composite Reliability value, which is desired to exceed 0.7, to ensure the reliability of the model being tested.(Hair, 2014).

Table 3. Reliability & Convergent Validity Test Results

Variable	Composite Reliability	AVE
X1	0.898	0.639
X2	0.806	0.583
M1	0.873	0.696
M2	0.848	0.652
C1	0.870	0.692
C2	0.887	0.725
C3	0.906	0.762
Y1	0.840	0.639

Source: Author's elaboration, 2023

Table 3 shows the Average Variance Extracted (AVE) values for all variables, which

consistently reach figures above 0.5. These results indicate that the data collected in the context of this research can be considered valid. Furthermore, the Composite Reliability results show that the value for each variable exceeds the 0.7 limit. Therefore, it can be concluded that this research shows a significant level of reliability and validity of the data (Magno et al., 2022).

Table 4. R-Square Testing

Variable	R-Square
X1	0.522
X2	0.517
M1	0.785
M2	0.621
C1	0.522
C2	0.517
C3	0.389
Y1	0.699

Source: Author's elaboration, 2023

Evaluation of the structural model was also carried out using the R-Square test, as shown in Table 4. The evaluation results show that the R-Square value is close to 1, although it has not yet reached the middle value of the R-Square test criteria range for variable C3, which ranges from 0 to 1. Thus, it can be concluded that the variation in the dependent variable in this study can be explained by a model with an appropriate level of adequacy(Westfall & Arias, 2020).

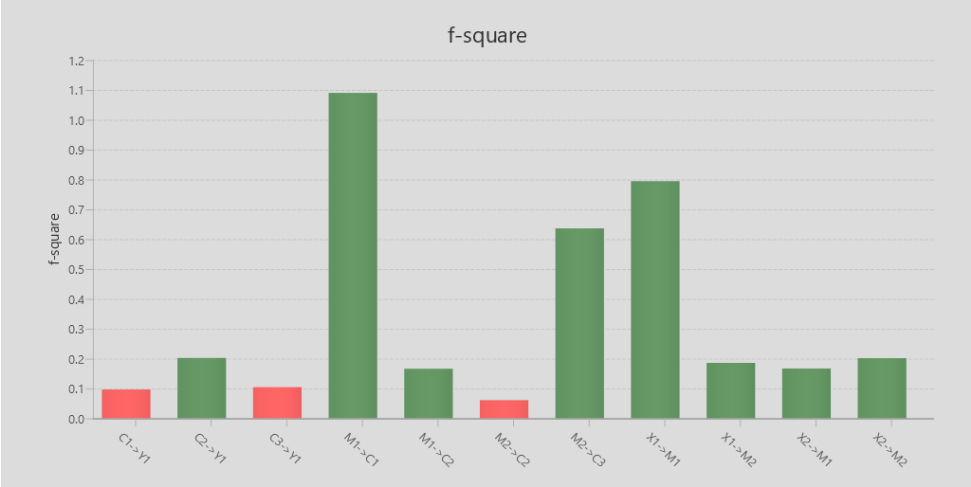

Figure 6. F-Square Test Results
Source: Author's Elaboration, 2023

Evaluation of the structural model was also carried out through the f-square test, where in Figure 4 the test results show that there are three relationships that are still below 0.1 out of the eleven relationships tested. Therefore, it can be concluded that there is a significant influence on the relationship between variables.

Total Effect Testing

Table 5. Total Effects Results

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistic	P Values
C1->Y1	0.293	0.265	0.141	2.072	0.038
C2->Y1	0.398	0.392	0.116	3.437	0.001
C3->Y1	0.244	0.275	0.112	2.182	0.029
M1->C1	0.722	0.714	0.107	6.722	0.000
M1->C2	0.471	0.473	0.215	2.191	0.028
M1->Y1	0.399	0.385	0.144	2.779	0.005
M2->C2	0.285	0.285	0.207	1.376	0.169
M2->C3	0.624	0.638	0.097	6.417	0.000
M2->Y1	0.265	0.288	0.119	2.225	0.026
X1->C1	0.463	0.466	0.093	4.959	0.000
X1->C2	0.419	0.424	0.103	4.085	0.000
X1->C3	0.256	0.250	0.109	2.345	0.019
X1->M1	0.641	0.654	0.081	7.888	0.000
X1->M2	0.411	0.383	0.143	2.879	0.004
X1->Y1	0.365	0.364	0.105	3.477	0.001
X2->C1	0.212	0.208	0.070	3.020	0.003
X2->C2	0.260	0.270	0.072	3.596	0.000
X2->C3	0.267	0.289	0.083	3.205	0.001
X2->M1	0.294	0.289	0.094	3.116	0.002
X2->M2	0.428	0.456	0.118	3.635	0.000
X2->Y1	0.231	0.244	0.065	3.534	0.000

Source: Author's elaboration, 2023

The results of the bootstrapping analysis in Table 5 reveal a number of key findings related to the total effect of the independent variable (X) on the dependent variable (Y) as well as the total effect between the control (C) and mediator (M) variables. First, there is a significant influence from C1 to Y1, with a total effect of 0.293, indicated by a T statistic of 2.072 and a p-value of 0.038. Second, C2 shows a stronger influence on Y1 with a total effect of 0.398, accompanied

by a T statistic of 3.437 and a p-value of 0.001, confirming its high significance. Furthermore, C3 also made a significant contribution with a total effect of 0.244 and a T statistic of 2.182 (p-value 0.029). At the mediator level (M), M1 shows a significant influence on C1, C2, and Y1, while M2 is only significant on C2 and C3, with an insignificant influence on Y1. Furthermore, the independent variables X1 and X2 provide a significant total effect on all related variables, strengthening their contribution in the model. Overall, the bootstrapping results provide strong support for the structure of the research model and encourage the conclusion that the relationships between these variables have substantial statistical significance(Abdi, 2021).

Discussion

How Did Digital Twins Update the Drive Thru Service Concept?

Digital Twins, as a technological innovation, can make a major contribution to the efficiency of drive-thru services based on the case data that has been presented. The restaurant case highlights the need for improvements in the drive-thru experience, with an emphasis on speed of service and implementation of technology (T. W. E. Suryawijaya et al., 2023). Through consumer surveys, it is known that long waiting times and lack of service friendliness are the main challenges faced by customers. In this context, the use of Digital Twins can provide a better understanding of traffic lanes, order patterns and staff performance at the drive-thru. By analyzing this data, restaurant owners can identify areas where efficiency can be improved, reducing wait times and increasing interactions with customers. It is important to note that the use of technology in restaurants, including automation and artificial intelligence, was rated positively by the majority of respondents(Tao et al., 2018). Thus, the future of DT computing involves advanced analysis and modeling techniques to meet the needs of the new agenda(Le & Fan, 2024). Therefore, integrating Digital Twins into drive-thru operations can be considered a step in line with consumer desires(Vrabič et al., 2018). For example, implementing AI voice assistants for faster ordering, personalized menus and smartphone payments can provide an effective solution to increase efficiency and customer satisfaction (Luna, 2023).

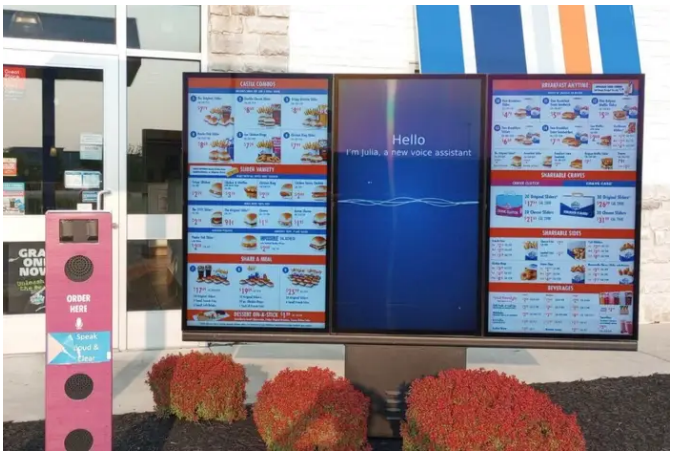

Figure 7. AI Assistant concept on Drive Thru service
Source:(Luna, 2023)

The retail business shows that the drive-thru concept can be applied in other sectors outside of fast food. For retailers, drive-thru can provide a quick and easy shopping experience without requiring customers to get out of their vehicles(Zhong & Moon, 2020). At the retail business level, especially in the context of retail stores and sales of non-food items, the use of drive-thru can create an efficient solution for pickup and delivery of goods (T. Suryawijaya & Aqmala, 2023). Through the implementation of Digital Twins, business owners can improve the design of pick-up areas and improve overall operational coordination(Tao et al., 2019). Data analysis regarding customer preferences and shopping patterns has become an invaluable tool for designing more personalized and efficient drive-thru experiences(Whitenack & Mahabir, 2022). Its significance is further elevated by the 'last mile' challenge in goods delivery, where

Digital Twins-based drive-thru is emerging as a promising alternative.

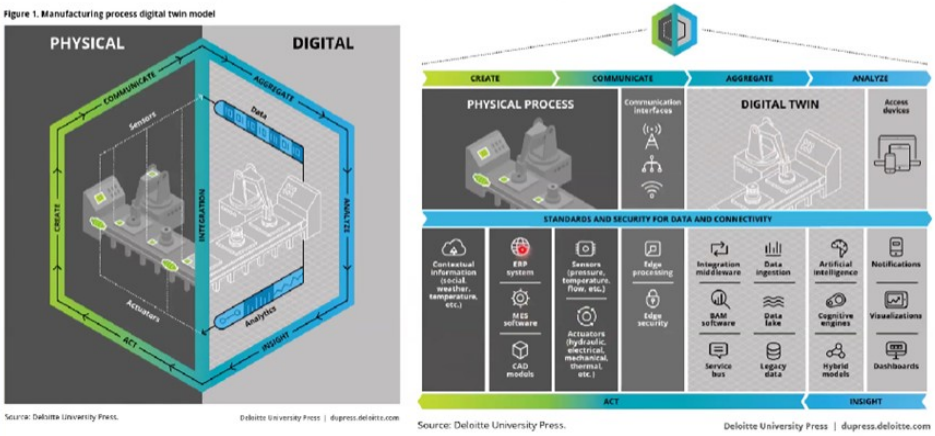

Figure 8. The process of translating physical and digital aspects of Drive Thru services Source:(Tao et al., 2018)

Overall, the effectiveness of Digital Twins in drive-thru service can be interpreted as a progressive step to improve customer experience, reduce wait times, and provide solutions that are adaptive to consumer trends. By harnessing the potential of data, business owners can make smarter decisions to optimize drive-thru operations, taking this innovation to the next level in the retail sector as a whole.However, it is important to recognize that the efficiency of the process using Digital Twins still means there is a delay in queuing time for some customers which makes them have to wait for orders(Lahrichi et al., 2020). The findings of this research show that Digital Twins are a technological innovation that can make a significant contribution to the efficiency of drive-thru services so that they can increase customer satisfaction.

Security in Using Digital Twins in the Business Sector

Digital Twins are poised to revolutionize the way industries operate by moving from physical asset management to increasingly automated, data-driven remote working modes. However, this potential revolution also carries huge risks if something goes wrong. The threat of cyber attacks, supply chain fraud, errors, missed maintenance, and other issues can threaten system integrity and erode trust in the data generated and used(Alcaraz & Lopez, 2022). Moreover, twins operating with false data are not twins. Digital Twins systems are essentially collections of different systems – disparate hardware and software components, physical environments, and actors that communicate and share data to create a holistic understanding of system operations and optimize decision making. In this context, the need arises to consider security and trust as integral elements, where risks and responsibilities are shared, and actions taken by one party have an impact on the other party(Hammar & Stadler, 2023). Therefore, Digital Twins security can be thought of as a team sport, applicable in both technical and commercial domains.

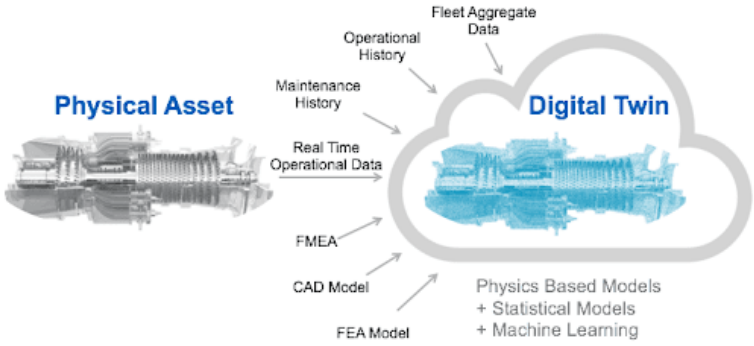

Figure 9. Digital Twins concept in supporting security systems
Source: (Timperi et al., 2023)

The Digital Twins Consortium is currently developing and documenting a security and trust approach that focuses on the specific and unique features of the Digital Twins system and its operations. The novelty of this research lies in presenting a comprehensive and detailed framework for properly assessing, adopting, and operating Digital Twins technologies and products, especially from a security perspective. Uniquely, this approach not only considers threat management in cyberspace, but also explores the dimensions of regulatory compliance, personal safety protection, and appropriate investment management(Timperi et al., 2023). In addressing shared risks and responsibilities, this research offers a holistic view of the security of Digital Twins as a team sport. The main contribution of this research is to provide a framework that embraces the entire spectrum of security challenges, including less exposed aspects such as investment management and regulatory compliance(Kurvinen et al., 2022; T. Suryawijaya & Aqmala, 2023). Thus, this research does not only focus on technical aspects, but also involves broader considerations, making it a comprehensive guide for end users and system integrators who wish to implement Digital Twins safely and effectively.

CONCLUSIONS AND IMPLICATIONS

In initiating an updated drive-thru service concept utilizing Digital Twins, it seems there is great potential to increase efficiency and customer satisfaction. Consumer survey data highlights key challenges customers face, such as long wait times and lack of service friendliness. By implementing Digital Twins, restaurant owners can better understand order patterns, traffic lanes and staff performance at the drive-thru. Analysis of this data allows identifying areas where efficiency can be improved, creating solutions such as AI voice assistants for faster ordering, personalized menus and smartphone payments.

This research is still limited by the number of respondents collected globally. Thus, the generalization of the results of this research is limited and the implications may only be adopted by one particular country or region. Another limitation that needs to be acknowledged is the limitation on frequency of use. This research may be limited in exploring variations in consumer responses or behavior that may develop over time. As a result, a deeper understanding of long-term dynamics may not be fully accommodated by existing limitations in frequency of use. The implications are not only limited to fast food restaurants, but can also be applied in the retail sector for a faster and easier shopping experience. However, despite the potential positives, the deployment of Digital Twins also presents significant cybersecurity challenges. In the context of digital asset management, the risk of cyber attacks, supply chain fraud, and data mismanagement can threaten system integrity and trust in data. Therefore, it is important to consider security as an integral aspect in Digital Twins implementation. The Digital Twins Consortium is developing a comprehensive approach to security and trust, involving cyber threat management, regulatory compliance, personal safety protection and investment management.

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