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Digital Transformation: Improving Operation Efficiencies Through AI-Predictive Analysis Network at a Vancouver Catering Services

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ABSTRACT

Vancouver Catering Services Limited (VCSL) is an international food company experiencing significant growth, resulting in expansion to a new location. However, there are operational challenges due to inadequate software infrastructure and outdated technologies. This paper suggests a thorough digital transformation plan to overcome these obstacles and facilitate the company's growth by implementing an AI-driven Predictive Analytics Network (APAN), a technological solution intended to improve productivity, streamline workflows, and boost the efficiency of food delivery. APAN aims to address operational challenges resulting from the company's expansion by automating repetitive tasks and optimizing key business processes. The company's technological infrastructure will be modernized, employee collaboration and communication will increase, customer service will be improved, and operating expenses will be decreased with the proposed digital transformation. This idea is valuable since it can help the business expand, enhance customer satisfaction, and guarantee more economical and efficient operations. This change will benefit employees, customers, and business partners, creating a more innovative and effective organizational culture.

1. INTRODUCTION

Digital transformation has become vital in today's company environment, contributing to growth, innovation, and competitive advantage. Businesses that embrace digital transformation go beyond simply implementing new technologies, especially those in sectors like the food industry that are expanding quickly (Jiang, 2020). It involves radically reevaluating how they function and provide value. This procedure entails incorporating cutting-edge digital technologies and approaches into each facet of a company to boost customer satisfaction, increase operational effectiveness, and promote long-term success (Leachman, 2023). The need for digital transformation is urgent and exciting for a large, global food firm that distributes packaged meals to supermarkets and hospitals and is about to move to a larger facility.

The Vancouver Catering Services Limited's (VCSL) legacy software and technology infrastructure must be improved to meet the business expansion, as evidenced by the recent rise in workers and activities. The company's strategic relocation presents a chance to restructure its operational processes and adopt a digital transformation plan to take advantage of fresh prospects and solve existing problems. Technological innovations such as cloud computing, artificial intelligence (AI), and data analytics can give businesses a competitive edge. These technologies enable companies to focus on customer-centric strategies, foster innovation, and become more agile. It goes beyond simple adoption when these technologies are incorporated. The current paradigm shift in company operations comprises enhanced protocols, reorganized frameworks, and innovative approaches to customer service (Deep, 2023).

One revolutionary development in business operations is digital transformation. The current era is experiencing the Fourth Industrial Revolution, driven by artificial intelligence (AI) and machine learning. This revolution significantly impacts enterprises, as adopting these technologies is essential for survival in the digital economy (Kaldero, 2018). An AI-driven Predictive Analytics Network (APAN) with solid cybersecurity measures. These technologies are necessary to improve the company's overall efficiency and security and to address the operational issues it is now facing.

The Predictive Analytics Network (APAN), powered by AI, will be crucial to streamlining the business's processes. APAN uses historical data to estimate demand, improve delivery routes, and streamline procedures. The system could predict future trends and provide recommendations based on historical data analysis (Elkan, 2010). These recommendations can increase worker productivity, reduce costs, and improve the efficiency of food delivery. By offering data-driven insights that facilitate improved decision-making and operational enhancements, this technology helps the organization overcome its present problems (Charles et al., 2022). For example, APAN can support the reduction of waste, optimization of inventory levels, and prediction of periods of peak demand, all of which contribute to cost savings and operational effectiveness.

Strong cybersecurity measures are also necessary in addition to APAN to safeguard the organization's data and systems. The organization is more susceptible to cyberattacks and data breaches as it grows and manages more data. The importance of cybersecurity has increased significantly in today's digital environment, where it is now a crucial component of both organizational strategy and national security. The leading cause of this increase is the growing dependence on information and communication technology (ICT) in various fields, such as business, government, and private industry (Tanriverdiyev, 2022). Advanced cybersecurity protocols like data encryption, network security, and access control must be implemented to protect sensitive data and preserve operational integrity (Abrahams et al., 2024). Cybersecurity measures foster trust with partners and consumers by ensuring compliance with data protection rules and safeguarding against external threats. In addition, a thorough cybersecurity strategy must include personnel training and a clearly defined incident response plan to guarantee that the business is equipped to handle any security breaches.

The business's corporate culture has a significant impact on the success of the digital transformation strategy. The effective adoption of new technology requires a culture that values innovation, encourages continuous development, and is agile (Deep, 2023). Adopting APAN and cybersecurity measures may encounter significant obstacles if the company's culture is reluctant to change or step out of step with the objectives of digital transformation (Oludapo et al., 2024). Resistance to new technologies may result in low implementation rates, ineffectiveness, and the loss of beneficial opportunities. To guarantee that staff members are involved, encouraging, and proactive in initiating the change, the organization's culture must be in line with its objectives regarding digital transformation (Butt et al., 2024).

The following sections will describe the comprehensive strategy for APAN's digital transformation. Before APAN's plan is implemented, reviewing the existing literature will give a general overview of the latest developments and best practices in the food industry regarding digital transformation. The following section will examine the benefits of APAN adoption in more detail, emphasizing how it can improve productivity, optimize service delivery, and streamline operations. The relevance of cybersecurity, including data protection and regulatory compliance tactics, will be covered in the following conversation. The summary of the suggested tactics, helpful implementation advice, and an emphasis on the expected advantages will bring the paper closer. This organized method aims to provide APAN with a clear and actionable roadmap for its digital transformation journey, guaranteeing efficient use of technology and encouraging a creative and productive organizational culture.

2. Literature Review

Liu et al. (2024) conducted a study that explores the impact of artificial intelligence implementation on the productivity of food processing companies in China. They examined datasets from 194 publicly traded companies located in Shenzhen and Shanghai, measured the volume of usage keywords related to the adoption of artificial intelligence in annual reports of the companies, and studied its relationship to the company performance, which was measured as a return on assets (ROA). Also, by using conceptual models, researchers investigated how artificial intelligence, company performance, and labour structure relate to each other and depicted the mechanism of AI application in the settings of labour force structure in companies undergoing digital transformation. The study concludes that AI positively affects the performance of enterprises in the food industry and improves the efficiency of the production process and competitiveness via its total factor productivity and impact on upgrading labour skills.

A study by Camaréna (2022) investigated the project of US company Rayfood Solutions, whose objective was to implement AI-based automation to extract and classify nutritional data from food and meal nutrition documents developed for school meal programs to reduce manual labour for data management. The research was conducted by observing the labelling data work of digitalization operators in data recognition and classification procedures. Also, the study examined documentation of a new project of Rayfood Solutions, such as data sheets with product specifications. The technologies that were implemented in this transformation included optical character recognition and machine learning algorithms. The study shows that implementing this technology increased saved time and data accuracy: as a result of the transformation, sets including 200 data sheets were processed with a 70-80 % decrease in time and the accuracy ranged from 95 to 98 %. Researchers suggest that this approach to automating food programs can improve sustainability by providing more accurate data for meal planning and procurement procedures.

Palakurti's study (2022) investigated the practical framework of implementing AI into the food production processes, ensuring food safety and quality control. The datasets for this technology are collected from various sources (sensor data, information about nutrition, chemical results, microbiological results), and this data allows AI to determine the level of food quality and to detect contaminations by using machine learning techniques such as deep learning, supervised learning, unsupervised learning. The research examines the impact of pre-processing data, data extraction, and selection of machine learning algorithms on the system's capability to deliver the expected performance in real-life conditions. It also explores the application of Internet of Things technology for predictive analytics. Palakurti concludes that integration of AI in quality control and food safety procedures can improve efficiency by decreasing the time and workforce needed for inspection and testing processes and can reduce the expenses of companies in the food processing industry by decreasing the number of substandard products that must be replaced during quality control procedures. The author investigates the issues that food processing might face in an attempt to adopt this technology, such as high implementation expenses and the necessity for high-level technical experts for the implementation of the technology and provides strategies to solve these problems, such as step-by-step implementation, training programs and implementing solid requirements for data privacy. According to the statistics provided by the World Health Organization food, food-containing contamination is considered a cause of 600 million cases of people getting ill annually (World Health Organization (WHO), 2022). thus, addressing this problem of food safety incidents attracts much attention from research and business communities. For this particular reason, a lot of research literature is devoted to the application of artificial intelligence for food safety and food quality control, i.e. (Chen & Yu, 2021; Kudashkina et al., 2022; Lin et al., 2022; Suthar et al., 2024; Wu & Chien, 2021).

Chu et al. (2021) conducted a study comparing different data-driven routing solutions to improve vehicle routing decisions that can be implemented for last-mile food delivery. The study aims to use accurate data to improve vehicle routing by applying machine learning techniques. The researchers' findings show that traditional approaches to this problem struggle in settings with uncertain environmental conditions. Therefore, they reveal a Smart Predict-then-Optimize (SPO) framework that can improve vehicle routing decisions via prediction errors. The effectiveness of SPO is proved by conducting 1,000 simulations containing the exact value of feature vectors. The latter predicts and calculates travel costs for different routing decision solutions. The article concludes that the integration of machine learning for route optimization is very effective for real-life tasks in the food industry, such as last-mile delivery. Authors reveal that SPO has 5 % lower costs compared to traditional methods, proving that this approach has the potential for improving vehicle route optimization.

In their research to build an AI-powered demand forecasting model for the food supply chain, Nassibi et al. (2023) used a vast dataset from SAP's platform of a chocolate company in the Kingdom of Saudi Arabia. This dataset had many attributes for prediction, and the training model used sales transaction data for the five products that were the most selling across ten cities. The research aimed to forecast future sales based on factors such as city, distribution channel, and data about previous transactions that will, in turn, increase the efficiency of the supply chain, leading to a decline in food waste level. Nassibi et al. concluded that forecasting demand using Machine Learning algorithms can improve supply chain management for food enterprises. In addition to this, research proves that the demand forecasting model that uses the Long Short-Term Memory (LSTM) algorithm outperforms the model using the Support Vector Machine (SVM) algorithm: findings show that the LSTM model has 77 % fewer errors in demand forecasting than the SVM model.

All in all, there are a lot of research and cases of practical utilization of AI, machine learning and predictive analytics tools that have a significant positive impact on the business performance of companies from the food industry all over the world through improving the process of delivery, the overall productivity of the company, increasing the efficiency of operations, etc. However, there is still a gap for holistic solutions that will be implemented in the food industry and capable of simultaneously transforming the abovementioned aspects of the business operations of food industry companies. Therefore, the solution proposed in the following parts of this paper can help eliminate this gap.

3. METHODOLOGY

Improving productivity and customer satisfaction is a twin challenge facing any food industry. These issues are interrelated because by efficiently enhancing their operations, food companies will vastly enhance employees' productivity, improving their customers' services, thereby increasing customer satisfaction. Speed of delivery, precision in operation, flexibility to changes in the environment, and quality of services are paramount to a fast-growing food company's survival. This research is designed to provide an integrated solution to VCSL, a food company experiencing growth and expansion. It proposes a digital technology that will give them the edge needed to attain the optimum operation and service quality necessary to meet their expansion and customers' needs.

The research was conducted between August and September 2024 across four districts in Vancouver: Yaletown, West End, Hastings, and South Granville, in British Columbia, Canada, where the respondents worked. A few surveys were conducted using questionnaires targeting 26 people: employees of the VCSL, including 3 supermarkets and 2 hospitals patronizing the VCSL. Unfortunately, our primary data collection was limited due to time and resource limitations. Consequently, we focused mainly on collecting more secondary data from existing sources, such as the National Restaurant Association, IBISWorld, Food and Drug Administration (FDA), U.S. Census Bureau, Research Publications, Online Reviews and Social Media Analytics, Corporate Reports, Trade Publications and External Surveys and Polls. Although these data were not updated in real time, they provided sufficient information for our research.

We used the non-probability judgmental (or purposive) sampling method to select respondents for our questionnaire due to the small sample size and our need for participants with a direct interface with the company's operations, products and services. Although this method is prone to researcher bias and may lead to poor representation of the population, adequate measures such as clearly defining the scope of the selection criteria and diversifying the sample were taken to eliminate these challenges.

The questionnaires were simple, unambiguous, easy to understand and structured to obtain objective responses. They were also divided into two types, one for the employees of food companies and the other for employees of the hospitals and supermarkets. Each was split into two sections. Section A consisted of questions relating to the respondents' personal information, while section B contained questions relating to the study's central issue. The questionnaires were closed-ended, and responses were ranked based on the degree of their opinion, which was classified under the following sub-headings ranging from 1 to 5, with 1 being very unsatisfied and 5 being very satisfied.

The questionnaires were validated by pilot testing with peers to identify areas of improvement before the final draft was handed to the respondents and retrieved on the spot, with 16 copies administered to the employees of VCSL and 2 copies each to the employees of the 3 supermarkets and the 2 hospitals. The questionnaires were administered during office hours from 8:00 AM to 4:00 PM Pacific Daylight Time on Wednesday, 28th of August, through Friday, 30th August 2024. All questionnaires were reviewed at collection to identify and correct possible errors.

An examination of the response from the employees of the supermarket and hospital revealed that VCSL needed to improve their delivery services in terms of speed, quality and quantity supplied, while the response from the company's employees revealed that the company needed to create an efficient work process to improve operations and enhance workers productivity. This shows that the company could not forecast demand, improve customer service, enhance workers' productivity and implement efficient workflows. The company needs an integrated approach to meet the identified challenges and strengthen its operations. Among VCSL's employees to whom the questionnaires were administered, 75% revealed they were willing to accept a technology to improve their productivity, 15% were indifferent, and 10% believed a new technology would complicate the current challenges.

The Technology Acceptance Model (TAM) was utilized due to its simplicity, general applicability, empirical validation, and support for change management. TAM is a broadly acclaimed theoretical framework that explains how stakeholders adopt and use technology (Musa et al., 2024). According to Davis et al. (1988), TAM was designed to model the acceptance of information technology by users, enabling us to understand and manage the variables that can influence the acceptance of our proposed technology by considering the stakeholders' perceived usefulness of the technology (PUT), their perceived ease of use of the technology (PEUT), their attitude to using the technology (ATUT), and their behavioural intentions or likelihood of continuously using the technology (BIT). Understanding how these variables influence acceptance of the proposed technology enabled us to design a process that mitigates these challenges and ensures a successful implementation of the technology.

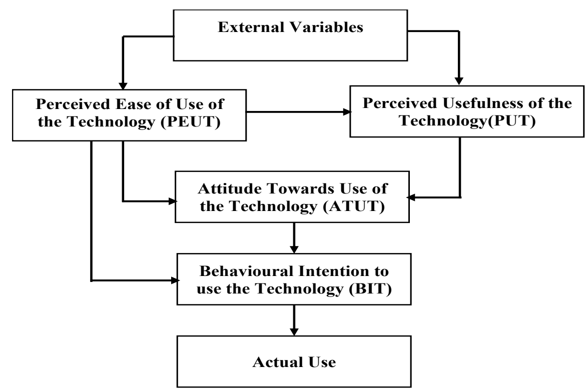

Figure 1. A Schematic of the Technology Acceptance Model Framework

To ensure a successful implementation and increase the likelihood of users' perception of the technology, we will focus on communicating the usefulness and benefits of the technology to users by revealing how the technology will improve their productivity. In addition, we will utilize an agile methodology in the design and implementation of the technology to ensure that users are involved in the process and that their concerns and challenges are addressed as soon as they are identified. Finally, we will roll out an integrated training plan using various training methods, increasing the perceived ease of use of the technology. Our research also acknowledged the limitations of the TAM model. As a result, we have provided recommendations such as targeted training of users and interface improvements to address this limitation. These suggestions will be explained in detail in our recommendations.

In a nutshell, our goal is to create a positive PEUT and PUT among users by strategically addressing the variables that may influence this perception and proactively developing an action plan that will ensure that the APAN is successfully implemented at the VCSL.

4. Analysis and Discussion

A Framework, Tools, and Technology

4.1 Desktop Level

Frameworks: A high-performing enterprise resource planning (ERP) platform with functionalities that enhance supply chain, inventory, and customer relationship management, ensuring efficient circulation and data processing.

Tools and Software: Installing Office 2021 or Google applications (Konur et al., 2023) to improve system compatibility and increase security. In addition, the operating system must be compatible with the ERP.

Hardware: Desktop computers will be built with the latest and effective hardware components and fitted with multi-core processors, 8GB RAM, and SSDs for applications and databases to enhance processing.

4.2 Network Level

Frameworks: A network framework that supports high-speed and efficient communication, with the quality of service (QoS) to handle sensitive data. This is especially important for purchases, sales, and other transactions such as inventory management.

Tools and Software: Network security appliances like firewalls, IDS/IPS, and WPA to overcome cyber threats and protect data transmission within the system.

Hardware: Gigabit Ethernet high-speed connectivity, routers, and switchers should be installed to help handle the network traffic caused by the new system.

4.3 Storage Level

Frameworks: A hybrid storage framework enabling on-premises and cloud environments at Scalpel will ensure scalability and disaster recovery solutions. This ensures integration at the local and remote organization levels to achieve the intended goals.

Tools and Software: Backup and storage solutions like Amazon S3, Microsoft Azure and Google Cloud Storage will be used for further safe and scalable data storage (Režek Jambrak et al., 2021). All the data will be encrypted when stored and transmitted, with an appropriate backup time.

Hardware: On-premise storage can be implemented through NAS devices, achieving faster local access to all essential data.

4.4 Mobile Level

Frameworks: Mobile systems should be able to interface with the centralized system to enable employees to conduct transactions securely from remote locations.

Tools and Software: Real-time information must be available for the field employees and managers, making this possible through pre-installed mobile applications. Mobile Device Management (MDM) solutions should be adopted to secure the system with security measures such as removal, encryption, and secured access.

Hardware: The devices should enable applications and support highly developed security measures so that the devices are operated effectively by employees working remotely or in the field.

4.5 Integration Across All Levels

To achieve end-to-end system integration across the desktop, the network, storage, and mobile levels, integration platforms such as MuleSoft, Talend, AWS Sagemaker, Kubeflow, Azure machine learning, or Apache NiFi should be used. To ensure data is collected in conformity and harmonized across different systems.

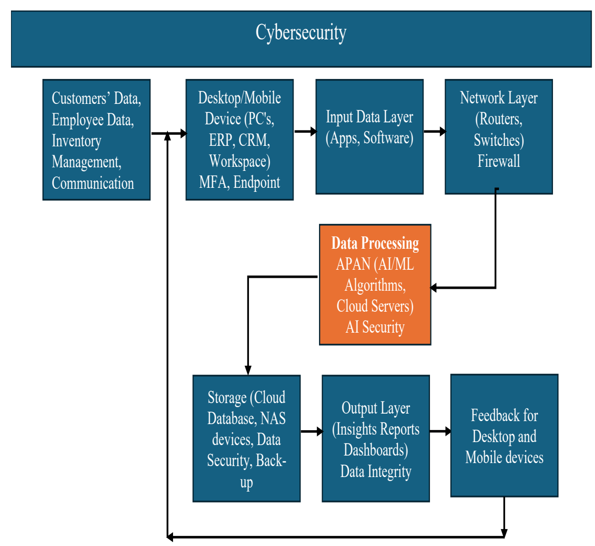

Figure 2 APAN Implementation Architecture

4.6 Overall Considerations

Security and Compliance: Use data encryption protocols during transmission, employ RBAC to protect the data, and adhere to the land regulations.

Scalability: The design will be flexible, allowing for future expansion and adaptation to new technological trends.

User Training: Onboarding training programs will be conducted for users to ensure optimum utilization of the technology.

B Cybersecurity Needs for Digital Transformation

Cybersecurity is highly required in the digital transformation of VCSL. The modern system interconnection ranges from supply chain management to handling customer data. These introduce several vulnerabilities that must be met with a well-rounded cybersecurity strategy.

Endpoint Security: Robust. EPP solutions include antivirus, anti-malware, firewall protection, and EDR solutions with sophisticated threat detection and automated responses that will be installed at the desktop and mobile level

Network Security: Firewall installation at the network's perimeter would be the first line of defence, controlling the entry and exit of traffic (Trung et al., 2021) to monitor suspicious activities and block malicious traffic automatically.

Data Encryption: Data at rest will use symmetric key encryption algorithms, such as AES-256, to encrypt sensitive information maintained in databases, file systems, and cloud storage.

Multi-Factor Authentication (MFA): MFA shall be required for all systems, although it is essential in systems containing sensitive information, such as financial transactions or customer data (Alahmadi et al., 2022). This would add another layer of security to account credentials since users would need to provide multiple verification passwords and a one-time code sent to their mobile device to access the system or network.

Regular Security Audits and Compliance Check: Regular security audits will ensure compliance with IT protocol. This would involve penetration testing for attack simulation and finding weak spots within the systems. Compliance audits will also be conducted to ensure compliance with data compliance regulations.

Employee Training and Awareness: Training programs will be provided to educate users on phishing, password creation and best practices related to data protection (Van Der Linden et al., 2020).

Incident Response Plan: The structure of handling and mitigating the consequences of a cybersecurity incident is based on an Incident Response Plan. It should spell out how an incident shall be handled, covering steps for detection, containment, eradication, and recovery, apart from communication with stakeholders.

C Technology Acceptance Model (TAM)

Scherer et al. (2018) noted that the successful implementation of the TAM framework rests on the (PEUT) and (PUT), as they influence ATUT and BIT, which ultimately influence the actual use of the technology. However, variables outside the main principles of the framework significantly influence the PEUT and PUT. Our analysis centers on these variables.

4.7 Identifying Employees Challenges

Some of the variables influencing employees' perception are prior experience with technology (XT), affinity for technology (AT), involvement in the technology design (ITD), the functionality, expressiveness and aesthetics (FEA) of the technology, users' level of education (EL), and their age.

According to Abdullah & Ward (2015), individuals with less XP are likelier to have an unfavourable PEUT and PUT. Secondly, Barz et al. (2024) examined that affinity for technology is crucial, as individuals interested in technology will be more likely to possess a favourable PEUT and PUT.

Furthermore, the lack of users' involvement in the technology design, as identified by (Leso & Cortimiglia, 2021), influences intrinsic involvement, resulting in users becoming negatively biased toward the technology's ease of use and usefulness.

In addition, Chen & Ye (2023) reveal that FEA, especially the users' interface, influences PEUT. Finally, the employee's level of education and age are crucial factors that influence PEUT and PUT. According to Burton-Jones & Hubona (2006), the level of education and the age of the employee has a significant influence on PEUT and PUT, as habits can become stronger with age, making it difficult to adjust to change while the higher the level of education an employee attains, the more likely they possess a favourable PEUT and PUT.

The six variables are depicted in Figure 1. To mitigate these challenges, the ADKAR Change Management (ACM) Model and an Agile Project Methodology (APM) will be adopted to mitigate the identified challenges.

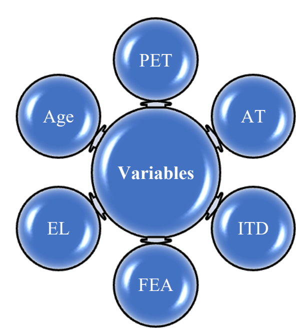

Figure 3. Variable Influencing Employees PEUT and PUT

D Strategies to Mitigate Identified Challenges

The challenges identified will be resolved by implementing ACM to manage the change process, mitigate the challenges resulting from PET, AT, Age and EL, and adopt an APM in developing the technology, thereby addressing the challenges caused by ITD and FEA.

Both strategies will be implemented simultaneously and in phases.

The ACM is a change management framework developed by (Prosci, 2020). It focuses on five key steps that must be achieved for effective change implementation: awareness, desire, knowledge, ability, and reinforcement. The APM focuses on incremental development processes (iterations) and timely delivery of working software that centers on users' collaboration and response to change.

4.8 Technology Planning and Change Awareness Stage

This stage involves identifying and notifying users of the organization's change needs. Users will also be required to provide their expectations and the challenges they expect the technology to solve. This will ensure their concerns are included in the plan and will address the IDT challenge. In addition, change ambassadors will be identified within VCSL to help disseminate the benefits of the technology.

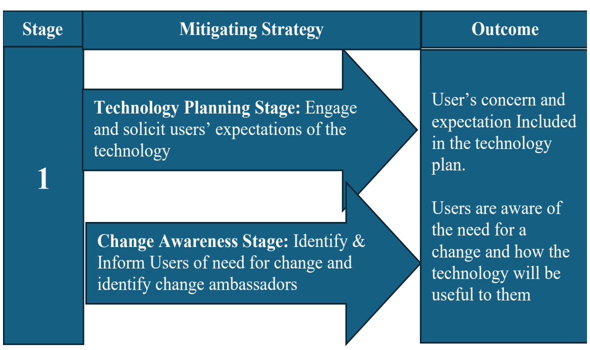

Figure 4. Technology Planning and Change Awareness Stage

4.9 Technology Iteration, Change Desire and Knowledge Building Stage

At this stage, employees will be engaged by the technology development team through appointed representatives (product owners) who will test and provide regular feedback on the FEA for further improvement as desired by the users. Employee training and education will also be ongoing through hands-on workshops and interactive tutorials to acquaint them with the technology. The feedback from this training will be passed on to the development team through the appointed product owners. At this stage, the FEA, PET, AT, Age and EL challenges will be addressed through continuous feedback, training and knowledge building.

4.10 Technology Release and Ability Building Stage

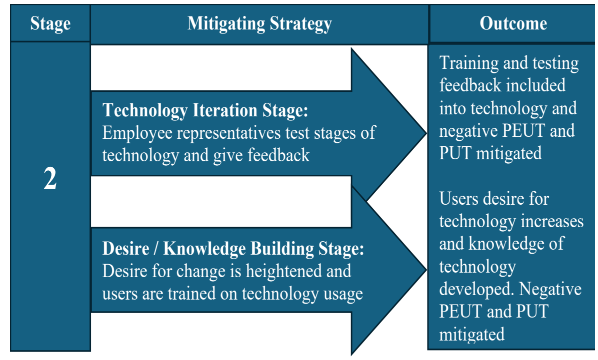

Figure 5. Technology Iteration, Change Desire and Knowledge Building Stage.

After the final product is released, the ACM Ability stage will also be initiated. The employee's ability to effectively use the technology is groomed through coaching, hands-on practice, and constructive feedback. IDT, FEA, PET, AT, Age, and EL challenges would be mitigated mainly at this stage's end, and a positive PEUT and PUT would be established.

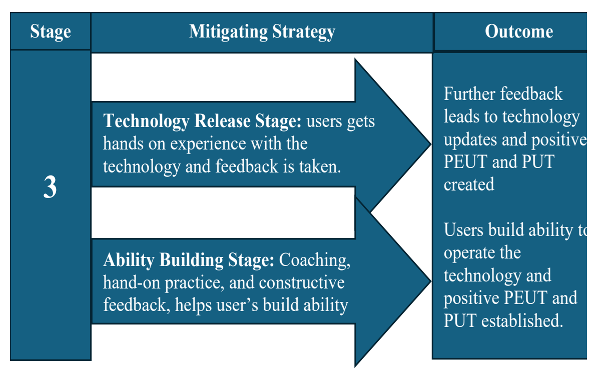

Figure 6. Technology Release and Ability Building Stage.

4.11 Technology Maintenance and Change Reinforcement Stage

Finally, while the technology is updated to ensure it continues to meet the users' needs, the last stage of the ACM will be initiated to reinforce the change and new employees' mentality through adopting the new measures, taking corrective actions and celebrating successes no matter how little as this will encourage employees to continue with the new process. At the end of this stage, the challenges of getting employees to adopt the technology will be eliminated.

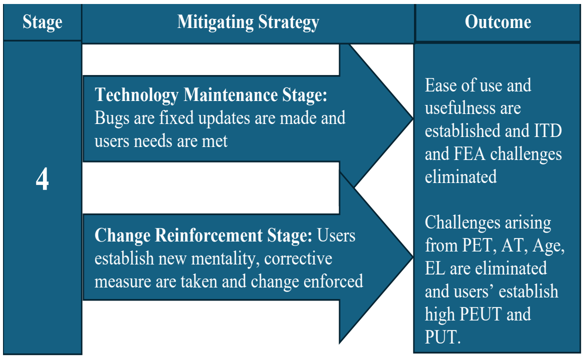

Figure 7. Technology Maintenance and Change Reinforcement Stage.

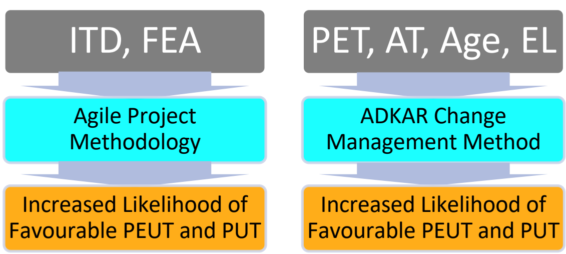

Figure 8. Strategies for Mitigating Challenges.

E Optimizing the Business Process

Vancouver Catering Services Limited must streamline its operations to optimize the new technology through an effective business re-engineering process; this is because the APAN will automate routine tasks, optimize resource allocation, and provide real-time data insights, which will lead to increased operational efficiency, improve customers service, reduce error and increase employee's productivity. Hence, the company must re-engineer its operations to leverage the benefits of digital transformation by harmonizing tasks with new technology, eradicating redundancies, and re-aligning its operations to optimize automation and customer satisfaction and improve overall productivity. Finally, the organization's culture must be transformed to foster innovation, creativity and agility, as technological transformation will only thrive in a supportive and agile environment.

F Industry and Technological Trends

The food industry is a very competitive field where cutting-edge technologies are widely used for all stages of the food production process. To ensure that VCSL remains competitive, we have adopted a merged Machine Learning system to enable the company to learn from past data and make predictions based on insights generated from the past data. This technology will grow capacity and capability because as the company gathers more data, the AI learns new patterns and trends due to the machine learning support. This gives VCSL a strategic advantage in its industry as it can anticipate future demands based on past trends, improve food delivery by making informed predictions, enhance customer experience and develop personalized offerings based on customers' needs and preferences, develop efficient workflow by analyzing process diagrams, workflows, and operational data, enhance communication by seamlessly integrating with the company's communication platforms, build robust data security and become robust data security.

An estimated 48 to 51 weeks is expected to implement APAN at VCSL. This will begin by defining the goal and objective of the technology. This will be followed by conducting a feasibility study of APAN's technical, operational and financial practicality, evaluating the current IT resources at VCSL, and gathering stakeholders' input as stated in our methodology. This will be followed by breaking the project into work packages (activities) and assigning timelines, budgets and teams to each work package. The next step will involve selecting the vendors for the hardware and software supply we have identified in the framework, tools, and technology section and the appropriate software developer to design and develop APAN. The design and development of APAN will follow this. Then, the unit, system, and user acceptance testing (UAT) will be conducted to ensure that APAN is appropriately integrated and functions to meet user expectations. This will be followed by user training, process documentation, and deployment of APAN, which will commence with a pilot lunch in small groups to identify and resolve challenges before a full launch across VCSL. In addition, the launch will also include the migration of existing data into APAN to ensure a robust database. Finally, a monitoring, maintenance and feedback process will be established to evaluate the performance of the technology in order to optimize its potential.

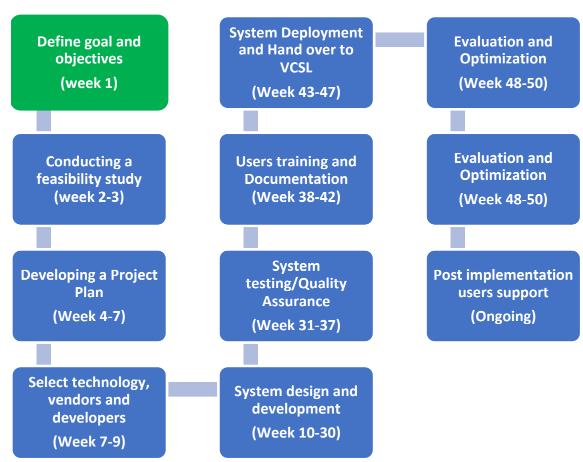

Figure 9. APAN Technology Implementation Network

APAN will transform VCSL's operations by such megatrends as sustainability, food waste reduction, and digitalization of the food supply chain, allowing real-time information about food production methods and the safety of products to be received (Galanakis, 2024).

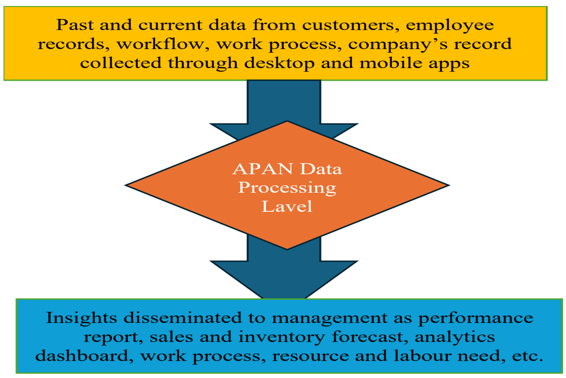

Figure 10. Data Analysis Process with APAN.

G Potential Risk and Challenges

The successful implementation of APAN in VCSL also depends on the proper identification and mitigation of potential challenges associated with the deployment of digital technology. Some of these challenges identified during our research include technical challenges, operational risks, stakeholder management, cybersecurity risks, and financial risks,

The technical challenges border on system functionality, expressiveness and aesthetics (FEA), integration issues, system failures, and data migration. In contrast, operational risks and stakeholder management challenges border on users' adoption, training and skill upgrade, stakeholders' buy-in and change management. The mitigation and contingency plans to manage these 3 risks have been discussed in our TAM framework: adopting an Agile Project Methodology (APM) and the ADKAR Change Management (ACM).

Furthermore, cybersecurity risks identify issues such as data breaches, data protection, user access, and authorization; the mitigation plan for this risk has been discussed under the cybersecurity needs section. Finally, the financial risk will be addressed in the next section: Associated Costs with The Implementation. Taking actionable plans to manage these risks and reduce their likelihood will help ensure that the implementation of APAN is successful in VCSL

H. Associated Costs with The Implementation

The budget for the proposed technology is based on our analysis of the expansion strategy of VCSL, the composition and state of its technology system, user size and usage level. The cost is divided into 4 categories: capital costs, one-time implementation costs, operational costs for running and maintaining the technology, security costs, and employee training costs. Tables 1 and 2 overview the costs of implementing ANAP for the 35 identified users.

The total budget is estimated between $304,500.00 and $423,500.00, and a range has been used instead of a fixed cost due to unforeseen cost variations resulting from inflation and interest rate adjustments.

Table 1: Technology Budget Estimate Analysis for Capital and Operational Cost

	Technology Budgeted	
	Cost Description	***Estimated Costs ($)***
	Capital Costs:	
1	Servers	50,000 – 70,000
2	Update of the computers	80,000 – 110,000
3	Storage NAS devices	30,000 – 40,000
4	Sensors	20,000 – 28,000
5	Wi-Fi access points	5,000 – 7,000
	Total	**185,000 -255,000**
	Operational costs:	
1	Cloud storage	9,000 – 14,000
2	Machine learning software license	8,000 – 12,000
3	Data software license	40,000 – 50,000
	Total	**57,000-76,000**
	Sub-total	**242,000 – 331,000**

Note. AZoSensors, 2024; Buffalo, 2024; D-Link, 2024; Google Cloud, 2024; Lenovo, 2024; Microsoft Azure, 2024; Oracle, 2024.

According to Collis (2021), the initial cost of implementing APAN will significantly impact the company's finances due to the cost of the technology and the cost of change management. In addition, this technology requires regular maintenance and might lead to increased payroll expenses, as highlighted by Gibson (2024). Furthermore, the project might result in cost overrun due to unforeseen challenges during implementation. These risks may result in a cash flow problem for VCSL, which is a significant risk to the company.

However, like all risks, organizational success is potentially high if the risks are appropriately identified and managed, such as spreading the capital cost over the implementation period of 48 to 50 weeks, reducing the financial burden to VCSL. Furthermore, if APAN is appropriately implemented, it has the potential to increase VCSL's revenue, return on investment and cash flow in the short and long term through improved customer satisfaction and the creation of efficient and effective business processes.

Table 2: Technology Budget Estimate Analysis for Security and Training

	Technology Budgeted	
	Cost Description	***Estimated Costs ($)***
	Security costs:	
1	Network Firework	2,700 – 4,000
2	Intrusion detection and prevention system	12,000 – 17,000
3	Antivirus solution	4,800 – 6,500
4	**Total**	**19,500-27,500**
	Training Costs:	
1	Consulting for employees	15,000 – 23,000
2	Courses and workshops for employees	20,000 -30,000
3	Training platform and materials	8,000 – 12,000
	Total	**43,000-65,000**
	Sub-total	**62,000 – 92,500**
	Gross Total	**304,000 – 423,500**

Note. Analytics8, 2024; AWS, 2024; Microsoft, 2024; LinkedIn Learning, 2024.

I. The Benefits of the Digital Transformation

VCSL will benefit immensely from implementing the APAN as it will streamline its process, enhance its workforce productively, improve customer service, and increase its overall operations. These benefits are broadly explained below.

Improve Food Delivery and Enhanced Customer Experience: APAN's predictive analysis capability enables it to forecast demand from past VCSL sales records and provide management with insight for speedy and efficient service delivery decisions. Yucel (2018) reported that AI-powered predictive systems can reduce waste and operational costs. This will also enable VCSL to understand its customers' needs and preferences, resulting in better customer service decisions and improved customer experience, as Schweer & Sahl (2017). This will also enable VCSL to develop personalized offerings, increase customer satisfaction, attract more clients and retain their existing ones.

Develop Efficient Workflow and Enhance Worker Productivity: Through its access to the VCSL work schedule, process diagrams, workflows, and operational data, APAN can analyze work and resource allocation scheduling plans. The insight from this analysis will provide management with accurate data to assign workers to critical areas, mitigate idle time, eliminate bottlenecks, and make informed workflow decisions that increase productivity.

Innovation and Agility: According to Palfreyman & Morton (2022), digital tools allow companies to adopt the importance of continuous improvement in their operations. The deployment of APAN allows VCSL to create an environment that supports continuous improvement, problem-solving, and informed decision-making, a recipe for innovation and agility.

Enhance Communication: The ability of APAN to integrate into VCSL's existing communication platforms, such as Slack, Microsoft Teams, etc., enhances real-time information and updates to stakeholders, thereby improving communication and collaboration.

Robust Data Security: APAN deploys advanced security measures that help to protect VCSL from cyberattacks. These advanced security measures comprise access control and even data encryption.

Therefore, digital transformation has become beneficial to businesses in the food industry. These digital tools continue improving efficiency and customer experiences, furthering innovation and providing robust security measures.

5. CONCLUSION AND RECOMMENDATIONS

In conclusion, APAN will allow VCSL to transform its business by analyzing existing data to make informed predictions, enabling VCSL to make proactive decisions based on the insights provided by the technology. Our research also addressed challenges that can hinder the deployment of this technology, such as technical challenges, operational risks, stakeholder management, cybersecurity risks, and financial risks.

However, our proposal is burdened with some limitations, such as the limited size of our primary data, which may reduce the accuracy of our model, create bias in our analysis, increase the inability to detect patterns and may not adequately represent the population. Therefore, we recommend that further studies be conducted with a larger data size to improve the accuracy and reliability of the result, improve generalization, provide robust conclusions, enhance comprehensive training of the model, and increase the confidence of the findings.

Further limitations include time constraints, which limited the scope of the research, and the limitations inherent with the TAM framework, which resulted from its simplistic nature, its contextual limitations, such as its lack of incorporating factors such as organization culture, task complexity, etc., neglecting psychological factors such as risk, satisfaction and trust and its lack of feedback mechanisms. We recommend that future research should incorporate additional factors to TAM's framework to address its simplistic nature, measure actual usage of the technology, consider psychological factors and introduce feedback mechanisms, as these will enable the technology to provide more precise and insightful predictions of technology across diverse environments and platforms.

REFERENCES

[1] Abdullah, F., & Ward, R. (2015, December 14). Developing a general extended technology acceptance model for e-learning (GETAMEL) by analyzing commonly used external factors. ScienceDirect: Computers in Human Behavior. https://www.sciencedirect.com/science/article/pii/S074756321530251X?via%3Dihub.

[2] Abrahams, N. T. O., Ewuga, N. S. K., Dawodu, N. S. O., Adegbite, N. a. O., & Hassan, N. a. O. (2024). A REVIEW OF CYBERSECURITY STRATEGIES IN MODERN ORGANIZATIONS: EXAMINING THE EVOLUTION AND EFFECTIVENESS OF CYBERSECURITY MEASURES FOR DATA PROTECTION. Computer Science & IT Research Journal, 5(1), 1–25. https://doi.org/10.51594/csitrj.v5i1.699

[3] Alahmadi, A.N., Rehman, S.U., Alhazmi, H.S., Glynn, D.G., Shoaib, H. and Solé, P., 2022. Cyber-security threats and side-channel attacks for digital agriculture. Sensors, 22(9), p.3520. https://doi.org/10.3390/s22093520

[4] Analytics8. (2024, August 8). Data & Analytics Strategy Services Page. Retrieved from Analytics8 website: https://www.analytics8.com/services/data-strategy-consulting-services/

[5] AWS. (2024). Intrusion Detection and Prevention. Retrieved from Amazon Web Services, Inc. website: https://aws.amazon.com/mp/scenarios/security/ids/

[6] AZoSensors. (2024). AZoSensors Equipment. Retrieved from AZoSensors website: https://www.azosensors.com/equipment-index.aspx

[7] Barz, N., Benick, M., Dörrenbächer-Ulrich, L., & Perels, F. (2024). Students' acceptance of e-learning: Extending the technology acceptance model with self-regulated learning and affinity for technology-discover education. SpringerLink. https://link.springer.com/article/10.1007/s44217-024-00195-7

[8] Buffalo. (2024). TeraStationTM 71210RH Series - Rackmount | Buffalo Americas. Retrieved September 10, 2024, from Buffalotech.com website: https://www.buffalotech.com/products/terastation-7010-series-rackmount

[9] Butt, A., Imran, F., Helo, P., & Kantola, J. (2024). Strategic design of culture for digital transformation. Long Range Planning, 57(2), 102415. https://doi.org/10.1016/j.lrp.2024.102415

[10] Camaréna, S. (2022). Artificial Intelligence (AI) for Sustainable Institutional Food Systems: Implementing AI Tools for School Nutrition Program Management in the United States of America. Frontiers in Sustainable Food Systems, 6. https://doi.org/10.3389/fsufs.2022.743810

[11] Charles, V., Rana, N. P., & Carter, L. (2022). Artificial Intelligence for data-driven decision-making and governance in public affairs. Government Information Quarterly, 39(4), 101742. https://doi.org/10.1016/j.giq.2022.101742

[12] Chen, S., & Ye, J. (2023). Understanding consumers' intentions to purchase Smart Clothing using PLS-sem and fsQCA. PLOS ONE. https://journals.plos.org/plosone/article?id=10.1371%2Fjournal.pone.0291870

[13] Chen, T.-C., & Yu, S.-Y. (2021). The review of food safety inspection system based on artificial intelligence, image processing, and robotic. Food Science and Technology. https://doi.org/10.1590/fst.35421

[14] Chu, H., Zhang, W., Bai, P., & Chen, Y. (2021). Data-driven optimization for last-mile delivery. Complex & Intelligent Systems, 9(3), 2271–2284. https://doi.org/10.1007/s40747-021-00293-1

[15] Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1988). User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. ResearchGate. https://www.researchgate.net/publication/227446117_User_Acceptance_of_Computer_Technology_A_Comparison_of_Two_Theoretical_Models

[16] Deep, N. G. (2023). Digital transformation's impact on organizational culture. International Journal of Science and Research Archive, 10(2), 396–401. https://doi.org/10.30574/ijsra.2023.10.2.0977

[17] D-Link. (2024). Nuclias Cloud-Managed AC2600 Wave-2 PoE Access Point - DBA-2820P. Retrieved from D-Link Shop Canada website: https://dlink.ca/products/nuclias-cloud-managed-ac2600-wave-2-access-point-dba-2820p

[18] Elkan, C. (2010). Predictive analytics and data mining.

[19] Galanakis, C. M. (2024). The Future of Food. Foods, 13(4), 506–506. https://doi.org/10.3390/foods13040506

[20] Google Cloud. (2024). Google Cloud Pricing Calculator. Retrieved from Google.com website: https://cloud.google.com/products/calculator?dl=CiRlZjUwMTc0Mi03YjljLTRkNTAtYjU3MS05MzBiOTA5MmYwZWMQCRokRTk1Q0E3OTctMzVBNC00N0M4LUE4NEUtNjA5MEZCMkM1OTE2

[21] Jagtap, S., Garcia-Garcia, G. and Rahimifard, S., 2021. Optimisation of the resource efficiency of food manufacturing via the Internet of Things. Computers in Industry, 127, p.103397. https://doi.org/10.1016/j.compind.2021.103397

[22] Jiang, X. (2020). Digital economy in the post-pandemic era. Journal of Chinese Economic and Business Studies, 18(4), 333–339. https://doi.org/10.1080/14765284.2020.1855066

[23] Kaldero, N. (2018). Data Science for Executives: Leveraging Machine Intelligence to Drive Business ROI. Lioncrest Publishing. https://dl.acm.org/doi/10.5555/3307102

[24] Konur, S., Lan, Y., Thakker, D., Morkyani, G., Polovina, N. and Sharp, J., 2023. Towards design and implementation of Industry 4.0 for food manufacturing. Neural Computing and Applications, pp.1-13. https://doi.org/10.1007/s00521-022-07768-3

[25] Kudashkina, K., Corradini, M. G., Thirunathan, P., Yada, R. Y., & Fraser, E. D. G. (2022). Artificial Intelligence technology in food safety: A behavioral approach. Trends in Food Science & Technology, 123, 376–381. https://doi.org/10.1016/j.tifs.2022.03.021

[26] Leachman, L. (2023b, March 17). Using technology to create a better customer experience. Harvard Business Review. https://hbr.org/2023/03/using-technology-to-create-a-better-customer-experience

[27] Lenovo. (2024). IdeaCentre AIO I (24″ Intel) All in One. Retrieved from Lenovo.com website: https://www.lenovo.com/ca/en/p/desktops/ideacentre/aio-500-series/ideacentre-aio-i-gen-9-(24-inch-intel)/len102d0035

[28] Lenovo. (2024). ThinkSystem ST250 V3. Retrieved from Lenovo.com website: https://www.lenovo.com/ca/en/p/servers-storage/servers/towers/thinksystem-st250-v3-tower-server/7dcea01jna

[29] Leso, B. H., & Cortimiglia, M. N. (2021, July 22). The influence of user involvement in information system adoption: An extension of Tam - Cognition, Technology & Work. SpringerLink. https://link.springer.com/article/10.1007/s10111-021-00685-w

[30] Lin, Y., Ma, J., Wang, Q., & Sun, D.-W. (2022). Applications of machine learning techniques for enhancing nondestructive food quality and safety detection. Critical Reviews in Food Science and Nutrition, 1–21. https://doi.org/10.1080/10408398.2022.2131725

[31] Liu, H., Wang, Y., & Yan, Z. (2024). Artificial Intelligence and Food Processing Firms Productivity: Evidence from China. Sustainability, 16(14), 5928–5928. https://doi.org/10.3390/su16145928

[32] LinkedIn Learning. (2024). LinkedIn Learning. Retrieved from Linkedin.com website: https://learning.linkedin.com/content/me/author-training/en-us/author-test-pages/adobe-target-staged-content/lls-72/nav-var-1. https://cseweb.ucsd.edu/~elkan/255/dm.pdf

[33] Microsoft. (2024). Microsoft Defender for Business | Microsoft Security. Retrieved from Microsoft.com website: https://www.microsoft.com/en-ca/security/business/endpoint-security/microsoft-defender-business#Microsoft-defender-plans-and-pricing

[34] Microsoft Azure. (2024). Pricing - Machine Learning | Microsoft Azure. Retrieved from azure.microsoft.com website: https://azure.microsoft.com/en-us/pricing/details/machine-learning/

[35] Musa, H. G., Fatmawati, I., Nuryakin, N., & Suyanto, M. (2024). Marketing research trends using technology acceptance model (TAM): a comprehensive review of researches (2002–2022). Cogent Business & Management, 11(1). https://doi.org/10.1080/23311975.2024.2329375

[36] Nassibi, N., Fasihuddin, H., & Hsairi, L. (2023). Demand Forecasting Models for Food Industry by Utilizing Machine Learning Approaches. International Journal of Advanced Computer Science and Applications, 14(3). https://doi.org/10.14569/ijacsa.2023.01403101

[37] Oludapo, S., Carroll, N., & Helfert, M. (2024). Why do so many digital transformations fail? A bibliometric analysis and future research agenda. Journal of Business Research, 174, 114528. https://doi.org/10.1016/j.jbusres.2024.114528

[38] Oracle. (2024). Cloud Cost Estimator | Oracle Canada. Retrieved from Oracle.com website: https://www.oracle.com/ca-en/cloud/costestimator.html

[39] Pacolli, M. (2022). Importance of Change Management in Digital Transformation Sustainability. ScienceDirect-IFAC-PapersOnLine. https://www.sciencedirect.com/science/article/pii/S2405896322030749

[40] Palakurti, N. (2022, September 1). AI Applications in Food Safety and Quality Control. ESP Journal of Engineering & Technology Advancements ER. 10.56472/25832646/JETA-V2I3P111

[41] Palfreyman, J., & Morton, J. (2022). The benefits of agile digital transformation to innovation processes. Journal of Strategic Contracting and Negotiation, 6(1), 26-36. https://journals.sagepub.com/doi/full/10.1177/20555636221079943

[42] Pandey, Ms. S., & Shanker Mishra, Dr. R. (2024). UNRAVELING THE ROLE OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) IN FOOD SYSTEMS. Futuristic Trends in Information Technology Volume 3 Book 1, 3, 279–290. https://doi.org/10.58532/v3bbit1p4ch1

[43] Pragmatic Institute. (2024). Data Science for Product Teams | Pragmatic Institute. Retrieved 2024, from Pragmatic Institute - Data website: https://www.pragmaticinstitute.com/data/

[44] Režek Jambrak, A., Nutrizio, M., Djekić, I., Pleslić, S. and Chemat, F., 2021. Internet of nonthermal food processing technologies (Iontp): Food industry 4.0 and sustainability. Applied Sciences, 11(2), p.686. https://doi.org/10.3390/app11020686

[45] Scherer, R., Siddiq, F., & Tondeur, J. (2018). The technology acceptance model (TAM): A meta-analytic structural equation modeling approach to explaining teachers' adoption of digital technology in Education. ScienceDirect: Computers & Education. https://www.sciencedirect.com/science/article/abs/pii/S0360131518302458?via%3Dihub

[46] Suthar, A., Sindhi, S., Kathiriya, J., Sharma, A., Singh, V., & Bhedi, K. (2024). Use of artificial intelligence (AI) in ensuring quality and safety of food of animal origin: A review. International Journal of Veterinary Sciences and Animal Husbandry, 9(2S), 240–247. https://doi.org/10.22271/veterinary.2024.v9.i2sd.1294

[47] Tanriverdiyev, E. (2022). THE STATE OF THE CYBER ENVIRONMENT AND NATIONAL CYBERSECURITY STRATEGY IN DEVELOPED COUNTRIES. National Security Studies, 23(1), 19–26. https://doi.org/10.37055/sbn/149510

[48] Trung, N.D., Huy, D.T.N. and Le, T.H., 2021. IoTs, machine learning (ML), AI and digital transformation affects various industries-principles and cybersecurity risks solutions. Management, 18(10.14704). https://doi.org/10.14704/107.2021

[49] Van Der Linden, D., Michalec, O.A. and Zamansky, A., 2020. Cybersecurity for smart farming: socio-cultural context matters. IEEE Technology and Society Magazine, 39(4), pp.28-35. https://doi.org/10.1109/MTS.2020.3026468

[50] Venkatesh, V., & Davis, F. D. (2020). A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. ResearchGate. https://www.researchgate.net/publication/227447282_A_Theoretical_Extension_of_the_Technology_Acceptance_Model_Four_Longitudinal_Field_Studies

[51] World Health Organization (WHO). (2022). Food safety. Who.int; World Health Organization: WHO. https://www.who.int/news-room/fact-sheets/detail/food-safety

[52] Wu, P.-J., & Chien, C.-L. (2021). AI-based quality risk management in omnichannel operations: O2O food dissimilarity. Computers & Industrial Engineering, 160, 107556. https://doi.org/10.1016/j.cie.2021.107556

[53] Yucel, S. (2018). Estimating the benefits, drawbacks and risk of digital transformation strategy. In 2018 International Conference on Computational Science and Computational Intelligence (CSCI) (pp. 233-238). IEEE. https://www.sciencegate.app/document/10.1109/csci46756.2018.00051