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Introduction

In the age of digital era, data has become one of the most important assets of modern enterprises. It directs key choices for the company, fuels the innovation processes, and provides the insights into customer behaviour and industry trends (Green et al., 2018). In addition to this, proper data and resource management has been adopted by many businesses as a means of utilizing data assets in businesses' favour. With the growing popularity and use of a business, there is an increase in demand for a product or service that the business offers, thus the need to maintain high computation power that could keep the data and other information running at an optimal level (Attaran and Woods, 2019). Scalability is a strategic imperative for businesses that are undergoing high rates of growth because it lets them to adapt to changing needs, deal with growing volumes, and provide customers with an appropriate experience. They do this scaling using various technology stacks and, on the safety, and reliability required to scale and expand the operations and user populations.

Orchid Tech Innovations Ltd. is prepared to increase its activities abroad due to its expanding customers, and Tokyo, Japan has been chosen as the location for a new office. In order to take advantage of the constantly changing landscape of digital marketing, the firm also aims to improve the services it provides by including more digital engagement and social media techniques. To evaluates the potential technology solutions for Orchid Tech Innovations Ltd.'s expansion, this report focusses on investigating and proposing technological stacks that may for needed to enable the expansion for seamless operations across geographies. Additionally, the report discusses potential big data issues associated with opening a foreign office, considering regulatory, legal, and technological factors. Through this analysis, the report aims to provide recommendations to support Orchid Tech Innovations Ltd.'s strategic goals and ensure successful expansion while mitigating risks associated with these technologies.

Technology Solutions Evaluation and Potential Alternatives

Customer Relationship Management (CRM) Systems:

According to Buttle and Maklan (2019), CRM, or customer relationship management, is the set of procedures, approaches, and tools used by businesses to track and evaluate consumer interactions and information across the course of the customer lifecycle. The goal is to improve customer service relationships and assist with customer retention and drive sales growth. CRM systems compile customer data across different channels and points of contact between the customer and the company, like gatherings client information from many channels and points of interaction between the client and the business. These may consist of the business's social media accounts, direct mail, live chat, website, phone number, and marketing materials. This system gives employees who interact with consumers comprehensive information about their personal details, past purchases, preferences for purchases, and concerns (AMOS, 2019). For Orchid Tech Innovations Ltd. to improve customer interaction methods, centralise customer data, and streamline communications, a complete CRM system should be considered. Leading CRM platforms like Salesforce, HubSpot, or Microsoft Dynamics offer a wide range of features, including contact management, lead tracking, and marketing automation. This CRM system could be cloud base or on-premise CRM. As described by Laaksonen (2022), companies might consider cloud CRM as a cost-effective option; however, cost might still be a concern because paying subscription fees for software can be more costly over time than investing in an on-premises model. The five main challenges in CRM are high cost, insufficient time, bad data quality, lack of communication, and limited technology and IT capabilities.

Furthermore, Orchid Tech Innovations Ltd. will be able to get insightful consumer data about their social media interactions and tailor their marketing efforts to the quantifiable reactions by combining social CRM with social media platforms. Furthermore, CRM systems will facilitate cross-functional collaboration among sales, marketing, and service teams by offering a comprehensive perspective of client interactions and enabling them to work together towards a same goal simultaneously (Rehman, 2019). Despite all of the developments in CRM technology,

a CRM system may easily devolve into little more than an elaborate database used to hold client data if it is not properly managed. To make it simple for consumers to obtain the information they want, data sets must be connected, dispersed, and organised. If data sources aren't linked and arranged in a single dashboard or interface, businesses may find it difficult to obtain a single perspective of the consumer. Outdated or duplicate customer data in systems makes tracking the customer journey more difficult.

Enterprise Resource Planning (ERP) Systems

Enterprise resource planning (ERP) systems are software that help businesses manage their core processes, such as finance, human resources, manufacturing, supply chain, services, and procurement. ERP systems can be on-premises or in the cloud, and they help coordinate data flow between business processes, providing a single source of truth (Amini and Abukari, 2020). ERP systems are designed around a single data structure that typically has a common database, which helps ensure that information is normalized and based on common definitions and user experiences. Deploying an ERP system can streamline Orchid Tech Innovations Ltd.'s business processes by integrating various functions into a single platform. Solutions like SAP, Oracle ERP, or Microsoft Dynamics 365 offer modules for data management, analytics, and reporting, could enable the company to make informed business decisions based on real-time insights. The business world is extremely competitive, and this is also true when it comes to drawing in and keeping clients. An ERP system may help improve customer relationship management, which is essential to an organization's ability to provide excellent customer service. Quicker customer service and a more individualised approach are made possible by a modern system like ERP software, which centralises all client data. Real-time data reporting is another feature that sets an ERP solution apart from other company management systems and is a major selling point. Making a well-thought-out plan for ERP deployment can be challenging, though, as ERP is a comprehensive tool for corporate administration. Simplifying the ERP software to meet the needs of the company and implementing role-based user training are the best ways to steer clear of these issues. Although customisation of the ERP solution has a tremendously advantageous, it may also be difficult and time-consuming sometimes because it must be constructed from the bottom up. The continuous operating costs of an ERP system, more especially an on-premises ERP

system, are another component of the cost to be considered. Using an ERP system that is cloud-based and is Software-as-a-Service (SaaS) capable of being operated from any location is the most effective option to eliminate this recurring expense.

Cloud-Based Solutions

Cloud computing offers a scalable and flexible platform for storing, processing, and analysing data, making it an ideal choice for Orchid Tech Innovations Ltd.'s expansion. Cloud-based solutions such as Amazon Web Services (AWS), Microsoft Azure, or Google Cloud Platform provide a range of services, including data storage, compute power, and analytics tools (Kaushik et al., 2021). By migrating their IT infrastructure to the cloud, the company can reduce hardware costs, improve data accessibility, and enhance collaboration between teams across different locations.

Furthermore, cloud-based systems come with integrated security features and compliance certifications that guarantee data privacy and regulatory compliance factors that are especially important when handling consumer data from various demographic groups (Akhtar et al., 2021). Historically, acquiring IT infrastructure, qualified developers, and system administrators required small and medium-sized businesses (SME) to make hefty upfront capital investments, which raised the total cost of ownership (TCO). Taking this into consideration, and keeping in mind that the economic benefits of cloud computing are sometimes characterised as a conversion of capital expenditures to operational expenses (CapEx to OpEx), the term "pay-as-you-go" better conveys the financial advantage to Orchid Tech Innovations Ltd. Also, for enterprises, cloud-based software solutions provide another important advantage: flexibility. According to Attaran, in 2018 who states that the main reasons why companies choose to move their operations to the cloud is the ability to quickly scale up or down as needed without the need for costly infrastructure investments. Cloud-based solutions for businesses can include Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). These services can offer different levels of flexibility, control, and management to meet different business needs.

Big Data Technologies and Data warehouse integration:

The field of big data technology is constantly evolving to meet the needs of businesses, focusing on integrating crucial aspects of operations and information processing in real time regardless of

the complexity of the data (Kache 2017). Primarily, this technology is made to analyse, process, and extract data from massively complicated structures and a significant amount of data. While, according to Costa (2019), a data warehouse is an enterprise system that is used to analyse and report on structured and semi-structured data from many sources, including marketing automation, customer relationship management, point-of-sale transactions, and more. Ad hoc analysis and customised reporting are best served by data warehouses. The primary purpose of a data warehouse is to provide a central repository of information that can be quickly analysed and queried to generate relevant insights (Moscoso-Zea et al., 2018). Incorporating big data technologies is essential for Orchid Tech Innovations Ltd. to effectively manage and analyse large volumes of diverse data from multiple sources. Big data platforms such as Apache Hadoop, Apache Spark, or Cloudera offer distributed computing capabilities, enabling parallel processing of massive datasets across clusters of commodity hardware.

Orchid Tech Innovations Ltd. can obtain insightful information from unstructured data sources including social media postings, website logs, and consumer reviews by utilizing big data technology. The organization can carry out sophisticated data analysis, predictive modelling, and machine learning algorithms thanks to advanced analytics tools like TensorFlow, Apache Hive, and Apache Pig. This allows for data-driven decision-making and customized marketing tactics. Orchid Tech can accomplish seamless data integration, guarantee data consistency, and provide stakeholders with timely and accurate insights for strategic decision-making by combining data warehouse solutions with current systems and Big Data technologies. To guarantee data quality and integrity, however, the effective integration of data warehouse systems necessitates meticulous planning, data modelling, and ETL (Extract, Transform, Load) procedures.

Recommendation

To support their expansion aspirations, Orchid Tech Innovations Ltd. would be best served by taking a hybrid strategy that makes use of big data technologies in addition to cloud-based CRM. For Orchid Tech Innovations Ltd., the hybrid cloud architecture provides an affordable way to handle its expanding data needs and global dispersion. In particular, Salesforce should be used by the business as its CRM system, and it should be integrated with big data platforms like Apache Spark to enable social media integration and advanced analytics. Combine this with a data

warehouse system to store and analyse data centrally. Salesforce provides a feature-rich CRM platform that is ideal for tracking sales funnels, automating marketing activities, and managing customer relationships. Its cloud-based architecture ensures scalability, security, and accessibility, making it an ideal choice for a growing business operating across multiple locations.

Critique of Relational Database Choice

The choice to implement a relational database storing transformed customer data from Python ETL task may be appropriate given the structured nature of this data. A relational database system provides for each column data attribute and each row has record. Furthermore, constraint techniques in relational databases, including primary keys, foreign keys, and unique constraints, are used to enforce data integrity. That's why the data is consistent and anomalies can't appear. Contrarily, this option may be considered less flexible or efficient one for data storage. To illustrate, a customer record could entail the existence of multiple cars or home addresses, thus it could be difficult to represent these in a Relational table. This is so because this is a one-to-many type of relationship that might be bit complicated to model in a Relational Database but without introducing redundancies. Like this, a NoSQL database such as MongoDB (with a capability to store multi-valued fields), in a sense, may be more adaptive. Scalability of relational databases might be sometimes concerned with large volumes of data amounts or complex queries. This implies that as regards the different data sources and types, the choice of NoSQL database or a hybrid strategy that combines both relational and NoSQL databases would be more suitable. Non-relational DB solutions like MongoDB or Apache Cassandra have horizontal scalability, flexibility, and schema-less data models which makes them more useful when it comes to managing big data or unstructured data.

2. Big Data Issues and Considerations

Data Regulations Compliance

Major markets such as the European Union and Japan have stringent data protection regulations GDPR and APPI respectively (Bendiek and Römer, 2019 and Suda, 2020). These regulations create strict guidelines about data handling and stipulate severe penalties for non-compliance. This includes the management of personal and sensitive data. Orchid Tech will need to ensure they

develop a clear understanding of the Japanese laws regarding data storage, sharing and communication, especially considering the expected exchange of customer data between the offices. In the European Union (EU), the General Data Protection Regulation (GDPR) imposes strict requirements on the processing and transfer of personal data, including provisions for obtaining explicit consent, implementing data protection measures, and notifying authorities of data breaches. Failure to comply with GDPR can result in hefty fines and reputational damage for companies operating in the EU.

Data Governance, Integration and Interoperability

As the company scales up and collects data from multiple sources, maintaining data governance and quality becomes crucial. Orchid Tech Innovations Ltd. should establish clear data governance policies and procedures to ensure data accuracy, consistency, and completeness. This includes defining data standards, implementing data validation processes, and conducting regular data cleansing and enrichment activities. Furthermore, integrating data from the UK and Tokyo offices presents challenges in terms of data format, structure, and compatibility. The company must develop a robust data integration strategy that accounts for differences in data schemas, languages, and cultural necessity. Standardizing data formats and implementing data mapping and transformation processes will be essential to ensure seamless data exchange and analysis.

Technological Issues

The expansion of Orchid Tech Innovations Ltd. into the international market will undoubtedly bring about several technological challenges associated with the scaling up of its operations. The company's current model of storing data in standalone silos would pose major issues while trying to handle increasing volumes of data generated from their Tokyo office. Coordinating and integrating data from remote and disparate databases would significantly increase the chances of redundancies, inconsistencies, and errors, which could adversely affect business decisions that rely on this data. To address this, the company needs to adopt a centralized or cloud-based data management system, enabling them to maintain a single source of truth and ensure seamless real-time data integration.

With regular interaction and data sharing expected between the UK and Japan offices, the issue of transfer speed and latency becomes critical. Large volumes of data being transferred across long distances often lead to increased latency, disrupting business processes reliant on real-time data. As the company begins to accrue more customer data, the risk of data breaches increases, necessitating robust measures to protect data from cyberattacks, unauthorized access, and data leaks. Moreover, the cost of managing and storing large volumes of data can be substantial. The company will need efficient data management strategies and cost-effective technologies that can scale without a proportional increase in costs, which might involve investing in advanced analytics and machine learning tools to glean valuable insights from the data quickly and effectively.

conclusion

Orchid Tech Innovations Ltd.'s expansion to Tokyo presents significant opportunities for growth and enhancing its service offerings, particularly in the realm of social media marketing and digital engagement. To support its expansion, Orchid Tech Innovations Ltd. should consider adopting cloud computing solutions, implementing a centralized CRM system, and leveraging big data integration and ETL tools. These technologies will provide the necessary scalability, flexibility, and data management capabilities to handle the increasing data volumes and ensure seamless collaboration between the UK and Tokyo offices.

However, the company must also address critical big data issues, such as data privacy, security, governance, and quality. Compliance with relevant regulations, such as GDPR and APPI, is essential to protect customer information and maintain trust. Establishing good data governance policies, implementing data validation processes, and investing in data cleansing and enrichment activities will help ensure data accuracy, consistency, and completeness.

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Appendix 1: Code implementation

```
import csv
import json
import xml.etree.ElementTree as ET
## Function to parse CSV data, merge JSON data, merge XML data, read text file
def parse_csv_data(file_path):
    """
    Parses CSV data and returns a dictionary.

    :param file_path: Path to the CSV file.
    :return: Dictionary containing parsed CSV data.
    """
    parsed_data = {}
    with open(file_path, newline='') as csvfile:
        csv_reader = csv.DictReader(csvfile)
        for row in csv_reader:
            full_name = row['First Name'] + ' ' + row['Second Name']
            parsed_data[full_name] = row
    return parsed_data
def merge_json_data(file_path, csv_data):
    """
    Merges JSON data with existing CSV data.

    :param file_path: Path to the JSON file.
    :param csv_data: Existing CSV data dictionary.
    """
    with open(file_path) as jsonfile:
        json_data = json.load(jsonfile)
        for record in json_data:
            full_name = record['firstName'] + ' ' + record['lastName']
            # Handle 'debt' field
            if 'debt' in record and isinstance(record['debt'], dict):
                debt_info = record['debt']
                dept_amount = debt_info.get('amount', 0)
                dept_time_period_years = debt_info.get('time_period_years', 0)
                del record['debt']
            else:
                dept_amount = 0
                dept_time_period_years = 0
            record['dept_amount'] = dept_amount
            record['dept_time_period_years'] = dept_time_period_years
            csv_data.setdefault(full_name, {}).update(record)
def merge_xml_data(file_path, csv_data):
```

```
    """
    Merges XML data with existing CSV data.

    :param file_path: Path to the XML file.
    :param csv_data: Existing CSV data dictionary.
    """
    xml_data = ET.parse(file_path).getroot()
    for user in xml_data.findall('user'):
        full_name = f"{user.attrib['firstName']} {user.attrib['lastName']}"
        record = {attr: user.attrib[attr] for attr in user.attrib}
        csv_data.setdefault(full_name, {}).update(record)
def read_text_file(file_path):
    """
    Reads a text file line by line and returns the data in a list.

    :param file_path: Path to the text file.
    :return: List containing each line of the text file.
    """
    data = []
    with open(file_path, mode='r', encoding='utf-8') as file:
        data = file.readlines()
    return data
# Read text file
txt_data = read_text_file('cetm50_23_4_data/user_data_23_4.txt')
for i in range(0, 4):
    print(txt_data[i])

# Parse CSV data
csv_data = parse_csv_data('cetm50_23_4_data/user_data_23_4.csv')

# Merge JSON data
merge_json_data('cetm50_23_4_data/user_data_23_4.json', csv_data)

# Merge XML data
merge_xml_data('cetm50_23_4_data/user_data_23_4.xml', csv_data)

# Convert merged dictionary into a unified dataset format
unified_data = list(csv_data.values())

# Define updates based on conditions
updates = {
    ('Valerie', 'Ellis'): {'credit_card_security_code': 762},
    ('Charlie', 'West'): {'salary': 2100, 'age': 52},
```

```
    ('Martin', None): {'pension': lambda x: 0.0015 * int(x) + int(x)}  # lambda function for dynamic update
}

# Apply updates
for record in unified_data:
    for (first_name, last_name), update_fields in updates.items():
        if record.get('firstName') == first_name and record.get('lastName') == last_name:
            for field, value in update_fields.items():
                if callable(value):
                    record[field] = value(record.get(field, 0))
                else:
                    record[field] = value
            print(f"{', '.join(update_fields.keys())} Updated")

# Drop specified columns from each record
columns_to_drop = ['First Name', 'Second Name', 'Age (Years)', 'Sex', 'Vehicle Make', 'Vehicle Model', 'Vehicle Year', 'Vehicle Type', 'debt']
for record in unified_data:
    record['Vehicle_Make'] = record['Vehicle Make']
    record['Vehicle_Model'] = record['Vehicle Model']
    record['Vehicle_Year'] = record['Vehicle Year']
    record['Vehicle_Type'] = record['Vehicle Type']
    for column in columns_to_drop:
        record.pop(column, None)

# Write unified data to JSON
with open('customer_unified_data.json', 'w') as jsonfile:
    json.dump(unified_data, jsonfile, indent=4)

#unified_data
# ! pip install pony pymysql
from pony.orm import *

# Database configuration
host = 'europa.ashley.work'
user_and_database = 'student_bi54up'
password = 'iE93F2@8EhM@1zhD&u9M@K'

# Set up Pony ORM database
db = Database()

# Bind the database with MySQL
db.bind(provider='mysql', host=host,
```

```
        user=user_and_database,
        passwd=password,
        database=user_and_database)

# Enable SQL debug mode
sql_debug(True)

# db.drop_table("customerentity", with_all_data=True, if_exists=True)
##############################################################################
class CustomerEntity(db.Entity):
    """
    Pony ORM model of records table
    """
    id = PrimaryKey(int, auto=True)
    firstName = Required(str)
    lastName = Required(str)
    age = Required(int)
    sex = Required(str)
    address_main = Required(str)
    address_city = Required(str)
    Vehicle_Make = Required(str)
    Vehicle_Model = Required(str)
    Vehicle_Year = Required(int)
    Vehicle_Type = Required(str)
    retired = Optional(bool)
    credit_card_number = Required(str)
    credit_card_security_code = Required(int)
    credit_card_start_date = Required(str)
    credit_card_end_date = Required(str)
    dept_amount = Optional(float)
    dept_time_period_years = Optional(float)
    dependants = Optional(str)
    marital_status = Required(str)
    salary = Required(int)
    pension = Optional(float)
    company = Optional(str)
    commute_distance = Optional(float)
    address_postcode = Optional(str)
    iban = Optional(str)

db.generate_mapping(create_tables=True)
sql_debug(True)
```

```
def push_data(db_class, data):
  """
    Uploads data to the specified database table.

    :param db_class: Pony ORM entity class representing the database table.
    :param data: List of dictionaries representing the data to be uploaded.
  """
  try:
    for entry in data:
        db_class(**entry)
    commit()
    print('Entries Added Successfully')
  except Exception as e:
        print(f"An error occurred while uploading data to the database: {e}")

push_data(CustomerEntity, unified_data)
```