NATIONAL SERVICE RESORT & COUNTRY CLUB (NSRCC)

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ABSTRACT

The National Service Resort & Country Club (NSRCC) is a web development project that utilizes Angular, .NET 6, SQL Server, and microservices architecture to provide a comprehensive booking platform for bungalows, facilities, and events. The main goal of this project is to offer a seamless experience for users to make reservations for their desired amenities at the resort. The application provides a user-friendly interface, which enables users to browse through the available bungalows, facilities, and events with ease. The platform also allows users to make payments for their reservations through secure payment gateways. The microservices architecture of the project ensures high scalability and fault tolerance, allowing the application to handle a high volume of traffic and ensure that users can make bookings without any disruptions. The use of Angular and .NET 6 provides a robust and efficient frontend and backend framework that ensures the application's responsiveness and speed. Overall, the National Service Resort & Country Club web development project is a sophisticated and efficient platform that provides users with a seamless booking experience for their desired amenities, making it an asset for the resort.

Keywords: Angular, .NET 6, SQL Server, Microservices, Agile Methodologies

1. INTRODUCTION (PROJECT OVERVIEW)

Strateq Group is a provider of software and integrated services intended for the healthcare, energy, and technology sectors. The company offered end-to-end information technology infrastructure systems integration, third-party software services and information technology maintenance services to key verticals such as disaster recovery and business continuity, oil and gas and healthcare sectors, enabling the clients to transform and grow their business. Strateq Group has been in business for over 28 years. Today, they are a leading technology enabler that has become a truly Malaysian and regional success story. They provide integrated solutions and services for a variety of industries including healthcare, oil & gas, banking and financial services, telecommunications, energy & utilities, education, consumer goods, manufacturing, and the public sector.

National Service Resort & Country Club (NSRCC) is a golf and country club set up to recognise the contributions of operationally ready NSmen to Total Defence ("National Service Resort & Country Club | National Service Resort & Country Club" n.d.). Its membership is open to NSmen who have performed national service, as well as full-time NSmen. Lately, NSRCC plans to enhance their old system. The old system is written for older version of Windows operating system approximately Windows 8 and below. Since it is an old system, it can only be run on computer or laptop and only administration can access them. The old system has underwhelming design and not too user friendly. The old system's user interface is tied to

text and numbers and using grey and blue colour from old application theme. Any booking need to conduct a call to administration and therefore, customers cannot see the picture of product they booked. NSRCC project is a web development project of a system to manage booking for bungalow, event and facilities. It is developed using Angular and .NET Frameworks as both front-end and back-end respectively while SQL Server is used for its database. Project has been gone through development for more than six months under Agile Methodology with approximately 70 team members.

2. RELATED WORKS

Booking system has been introduced a long time ago in our world. The first ever recorded automated booking system is the computer reservation system (CRS) called SABRE in 1957-1964. According to Altexsoft ("Online Booking History: CRSs, GDSs, and Online Travel Agencies | AltexSoft" n.d.), the system was based on SAGE, a ground-control environment developed for the US Air Force. Expertise in military equipment allowed IBM to reuse some of its groundworks for American Airlines and start creating a Semi-automated Business Research Environment or simply SABRE. SABRE became the first computerized booking system and it quickly boosted American's position in the market. Development was finished in 1964 when SABRE could process over 7,000 bookings per hour with nearly zero error rate. This shows how a booking system greatly improves the management of reservation.

Before we investigate the example of online booking system nowadays, we should look at the history of development in an online reservation system as it is the pioneer to our online booking system nowadays. A research study from Derick Wasonga Jabuto Odemba from IEEESEM shows a detailed development process of an online reservation system made using Simple Objects Access Protocol (SOAP) which is different web services compared to Representational State Transfer (REST) based web services that is being implemented by NSRCC Project ("An Investigation into Web Services: A case of an Online Reservation System A research study by Derick Wasonga Jabuto Odemba" 2019). While SOAP and REST share similarities over the HTTP protocol, SOAP is a more rigid set of messaging patterns than REST. The rules in SOAP are important because we can't achieve any level of standardization without them. REST as an architecture style does not require processing and is naturally more flexible.

An example of online booking system which provide success to people nowadays is the online hotel booking systems in Romania. According to ScienceDirect, around 56.8% of the total number of hotels in Romania offer clients the possibility to reserve a room online. Most of the major website modules is facilities information, contact information, reservation information, surrounding area information and management of websites (Rus & Negruşa 2014). The reservation method can be both either simple or complex way. Complex way includes about the room availability and tariffs. But in any cases, the reservation form must be easy to complete. Regardless of the support the website gave, the most important role is to attract incoming visits into bookings. Website is design/redesign a lot of time to ensure it will always attract customers. The reservation section also must be placed in easily reachable places by visitors. This is shown clearly through about 41.7% of total analysed websites. Other way of having an online reservation is through retail websites like booking.com as they are way easier to reach by clients, each property has its own web page, and the content of the web page is available in different languages.

Another good example of online booking is an online booking project called EAZY BOOKING from Asia Pacific University of Technology and Innovation by Syed Hasan published in November 2014 (Hasan n.d.). According to the documentation, the project will cater for clients around Malaysia, Singapore, and other Southeast Asia making them the nearest topography to

NSRCC. EAZY BOOKING is a web-based system developed using Visual Studio 2010, Adobe Dreamweaver, and .NET Framework as their backend. It is compatible with all common browser nowadays and the database is stored in MySQL, SQL Server, Microsoft Access and Oracle. Both the backend and database is similar to NSRCC project and therefore solidify of why this web application is chosen as literature review. But EAZY BOOKING has its own limitation which is it don't have the online banking for any transaction, and this will be solved in NSRCC Project.

Now we have seen examples of online booking project, what would be the need to have one in Southeast Asia? From a study of online booking among young Malaysian by Amirrudin Kamsin and Chang Sok Kin from University of Malaya, finds that majority of Malaysian prefer online booking if the process of online booking is smooth and easy (Kamsin & Kin 2005). Around 60.7% from 150 participants are willing to proceed with online booking with attractive design. The main reason is it ease them to navigate between pages in between the system. Another good reason is they can avoid wasting time on queue for check in. From business's point of view, online booking can smooth up management and reduces cost on having a receptionist. Both sides benefit from having an online booking showing how important it is to have an online booking system.

There was a study about an explorative design of a booking system to explore how the UI could be designed to be efficient while being satisfactory to use for novice admin users of the system (Gustafsson n.d.). A survey is done first to get the insight of how the prototype for testing should be done. The needs and behaviour of user when interacting with online booking is tabulated and studied to get the best prototype design. Then around seven participants is selected to do tasks revolving around the prototype and data such as time taken, behaviour and the number of errors they make. Based on the feedback, UI is changed and the testing is repeated until it get the desired level of usability. The result of this study is extraordinary because apparently you should include transitions and transformations in the design. The transitions and transformations can help show the relationship between different parts of the system while also adding a playfulness that adds to improve the usability of satisfaction of the system.

NSRCC is decided to be based on .NET environment. According to a journal NEFBDAA - .NET Environment for Building Dynamic Angular Applications by Damian Fraszczak. NEFBDAA is a high-level C#, .NET Core, and Angular web-based environment that encourages rapid development, utilizing clean, pragmatic design and the best, cutting-edge architectural designs to build SPA-consuming microservices with REST API (Frąszczak 2022). The framework reduces the hassle of web development by a lot so researcher can continue developing scientific work and modify their web-based applications with just a few line changes. The framework is very attributes focus based on UI forms and tables for Single Page Applications based on Angular frameworks. UI components configuration originates in the backend code, transferred to the frontend in JSON format, which can easily override producing the desired components. To start using the framework, user must have at least some knowledge in web development to configure the framework properly. Overall, .NET and Angular is a great web development framework for developer to use.

3. METHODOLOGY

3.1 Planning

NSRCC project is done in Agile software development pattern as it is the most flexible out of all software development pattern due to all requirements is not finalised yet and may changes from time to time ("What is Agile Software Development (Agile Methodologies)?" n.d.). In

Agile, every development is divided into a number of sprint where each sprint will focus on certain part of development first. At the start of the project, all team members will gather on meeting with Product Owner (PO) for briefing of the project. My team leader, Mr Richard Chuah make sure that every team members understand the scope of the project and also divide the workload equally to all team members. In every sprint, each workload is called 'story' and each story has their own story sizes.

The story size is referring to the story point where the number of days estimated to complete each story and the higher the story point, the harder the story is and will probably require more days to complete. The number of days for each story point is shown in the diagram below.

Story Size	Story Point	Estimated Days to Complete
XS	1-2	1 days
S	3-5	3 Days
M	6-8	7 Days
L	9-11	9 Days
XL	>11	> 9 Days

Table 3.1 Story Size

Every time a sprint is completed or about to start, team members will gather in a room to discuss about each story for in the sprint. Story is reviewed for several times to clarify what must be finished at the end of the story, the challenges or difficulties of the story and also time estimation to complete the story. Usually, enhancement or changes of past stories is on the XS while pages for doing Create, Read, Update and Delete (CRUD) is more on S. If the CRUD is related to other CRUD pages and is considered one of the core functions of the system, then it will be M. For anything related to payment gateway and others, L and above will be assigned to them according to the complexity of the requirement as discussed. Interns will be working on S and XS as well as bug fixes since interns' lack in experience and knowledge.

After estimating the scales on each story sizes, team members will choose and fill up stories until all stories is assigned. Members who completed their stories earlier than estimation can proceed to help other team members finishing their stories. Team leader makes sure the number of stories for each sprint is enough and not too much since each sprint has its own duration to prevent slow progress. Team leader must also stay vigilant that all stories is divided equally and each members understand clearly on what each stories about. Some stories will have higher priorities to be completed first since there are stories that need to be done sequentially. Each story is organised and monitored in Azure DevOps (ADO).

DevOps is the fast software development and deployment to enable continuous delivery of value to end users by achieving incremental software delivery ("Azure DevOps Tutorial: Introduction, Pipeline, Repos, Tools You Must Know" n.d.). Cross-discipline teams follow these phases of DevOps through their delivery pipeline to get products to market quickly. Meanwhile, Azure DevOps has several key differences from DevOps practiced in traditional development environments ("What is the difference between DevOps and Azure DevOps? - WebsiteBuilderInsider.com" n.d.). Traditional DevOps practices are often based on open-source software development model. Azure DevOps is based on the Microsoft model of software development, which emphasizes closed source software.

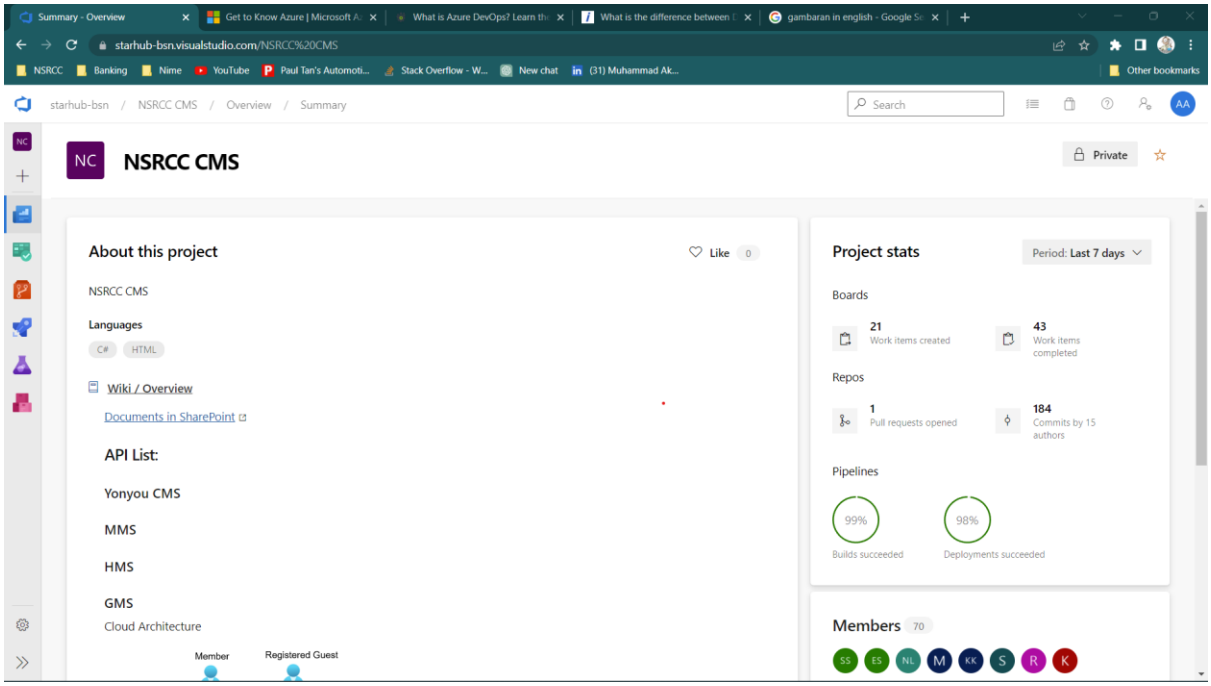

Diagram 3.1 Azure DevOps Overview of NSRCC Project

Diagram 3.1 shows the overview of the NSRCC Project. To access the project, user must have a Microsoft account and registered to the project. Members can find out the languages used in the project, application programming interface (API) list, cloud architecture, project stats and list of all members contributing.

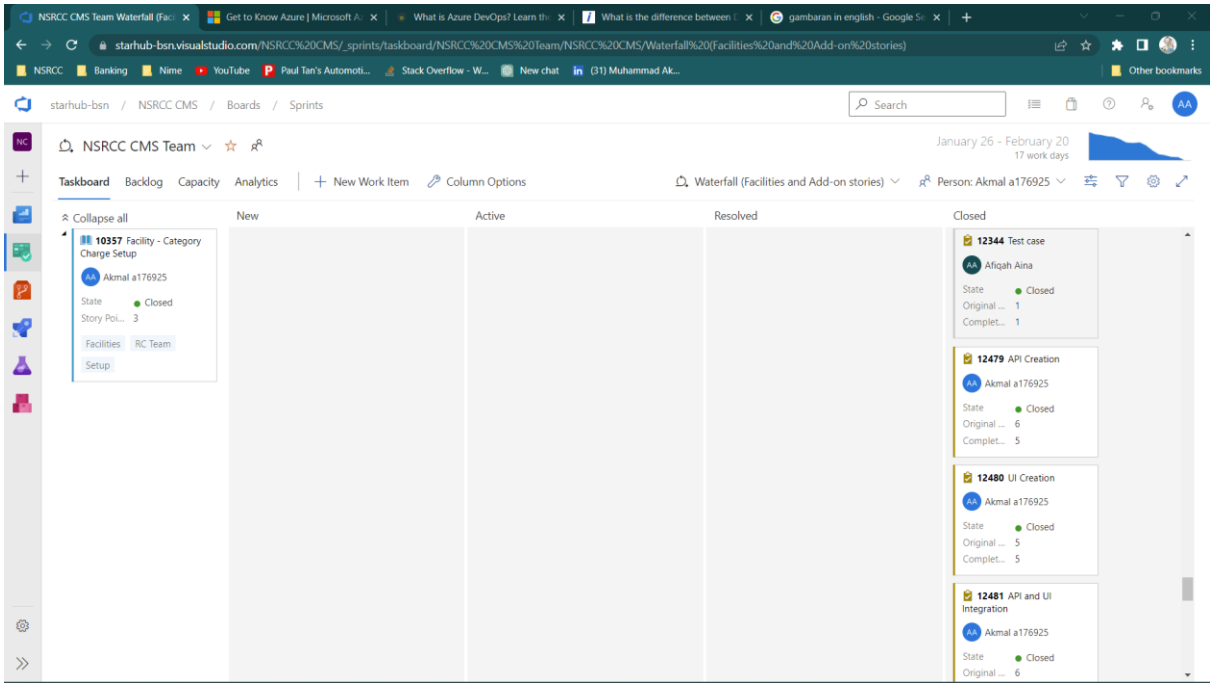

Diagram 3.2 Sprint Page in Azure DevOps

Diagram 3.2 shows a progress of a story in a sprint. On the most left side is where the title of the story and person working on it. There is also status of the story where it can be Closed if it is finished, Resolved if it is completed and waiting for testing, Active if a person is working on it and lastly New for newly added task. Each task for each stories is listed out in a box with

other information as well such as task numbers, title of the task, person assigned to the task, state of the task, Original and Completed. Original is for estimation on how many hours should be dedicated to the task while Completed is the actual time needed. Based on the diagram, all task is in Closed column and therefore the story's status is Closed.

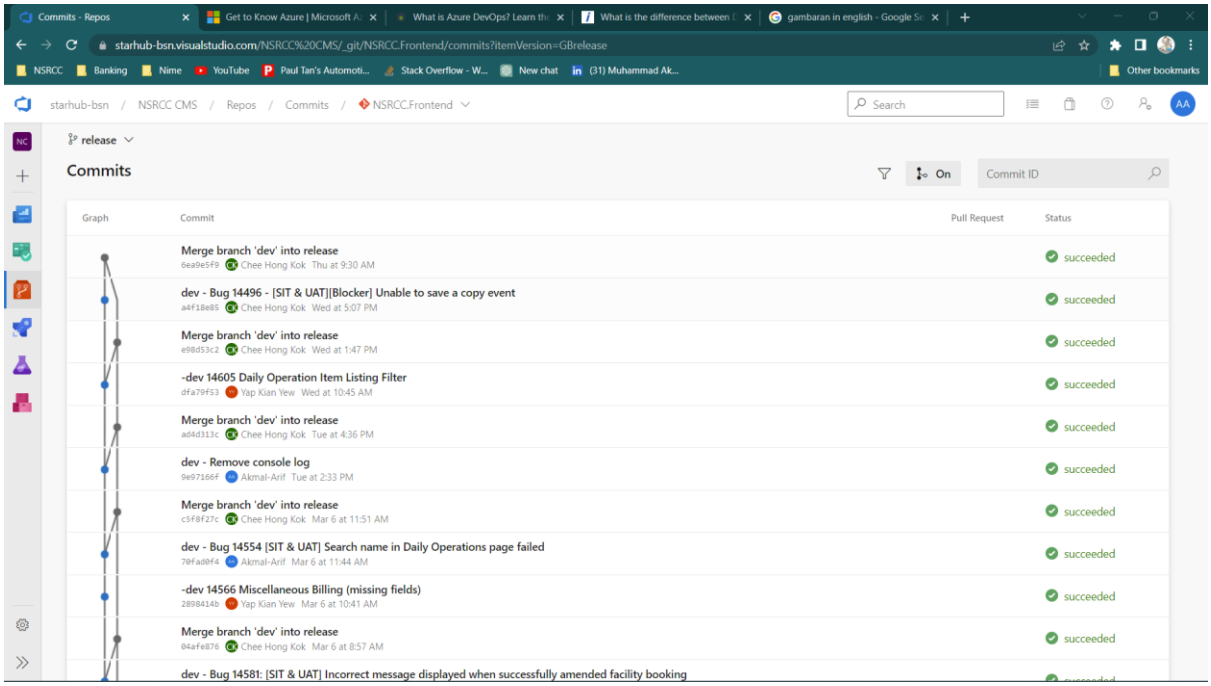

Diagram 3.3 Commits Page in Azure DevOps

Upon completion of task, code is pushed to the system and the commits is recorded as in Diagram 3.3. All code is pushed using Tortoise Git. Title of each commit is a brief description of what is committed and it is encouraged to push code as frequent as possible or at least twice a day. Name of the person commiting and also status of the commits is also recorded. Status can be either succeeded for successful commits, pending for commits in queue and failed for unsuccessful commits. When there is failed commits, it is encouraged to double check on the commits whether all file is correctly pushed and solve any merge conflict. All of this is to avoid merge conflict or accidentally deleting other member's code and everyone can see changes made to the project.

Since it is using Agile as software development pattern, members must always communicate with PO about the progress of the story. Questions or issues regarding the user requirement is discussed either in online meeting or from the ADO itself. To keep everyone on check, team leader conducts daily scrum (DS) with team members around 9AM everyday for everyone to report on their progress and any problem they faced. By this way, no one is left out to their task and team leader can identify problem as early as possible.

3.2 Design

3.2.1 Requirement Analysis

Functional Requirements

- The system must allow customers to book bungalows, events and facilities.
- Customers can select any bungalows, events and facilities based on date and type.
- When customers searching for bungalows, events and facilities, option shown must have the product details (Name, Price, Date) in the system.

- Customers able to cancel booking in the system.
- Customers can make amendment to booking in the system.
- Customers can pay for their booking in the system.
- Customers can login and logout of the system.
- Customers can setup their profile in the system.
- Administration can manage bungalows, events and facilities booking in the system.
- Administration can setup related features to bungalows, events and facilities booking in the system.
- Administration can log in and logout into the system.
- Administration can do GL Posting in the system.
- Administration can setup rate and payment-related thing to booking in the system.

Non-Functional Requirements

- System must be able to handle multiple transaction a time.
- System should support almost all the browsers (Internet Explorer, Safari, Chrome, Firefox and Microsoft Edge).
- System should be able to convert the price from Malaysia to USD and SGD.

3.2.2 System Design

Unified Modelling Language or UML is a combination of several object-oriented notations: Object-Oriented Design, Object Modeling Technique, and Object-Oriented Software Engineering. UML uses the strengths of these three approaches to present a more consistent methodology that's easier to use (“What is Unified Modeling Language | Lucidchart” n.d.). There are about 14 types of UML design but to simplify, only use case diagram will be given.

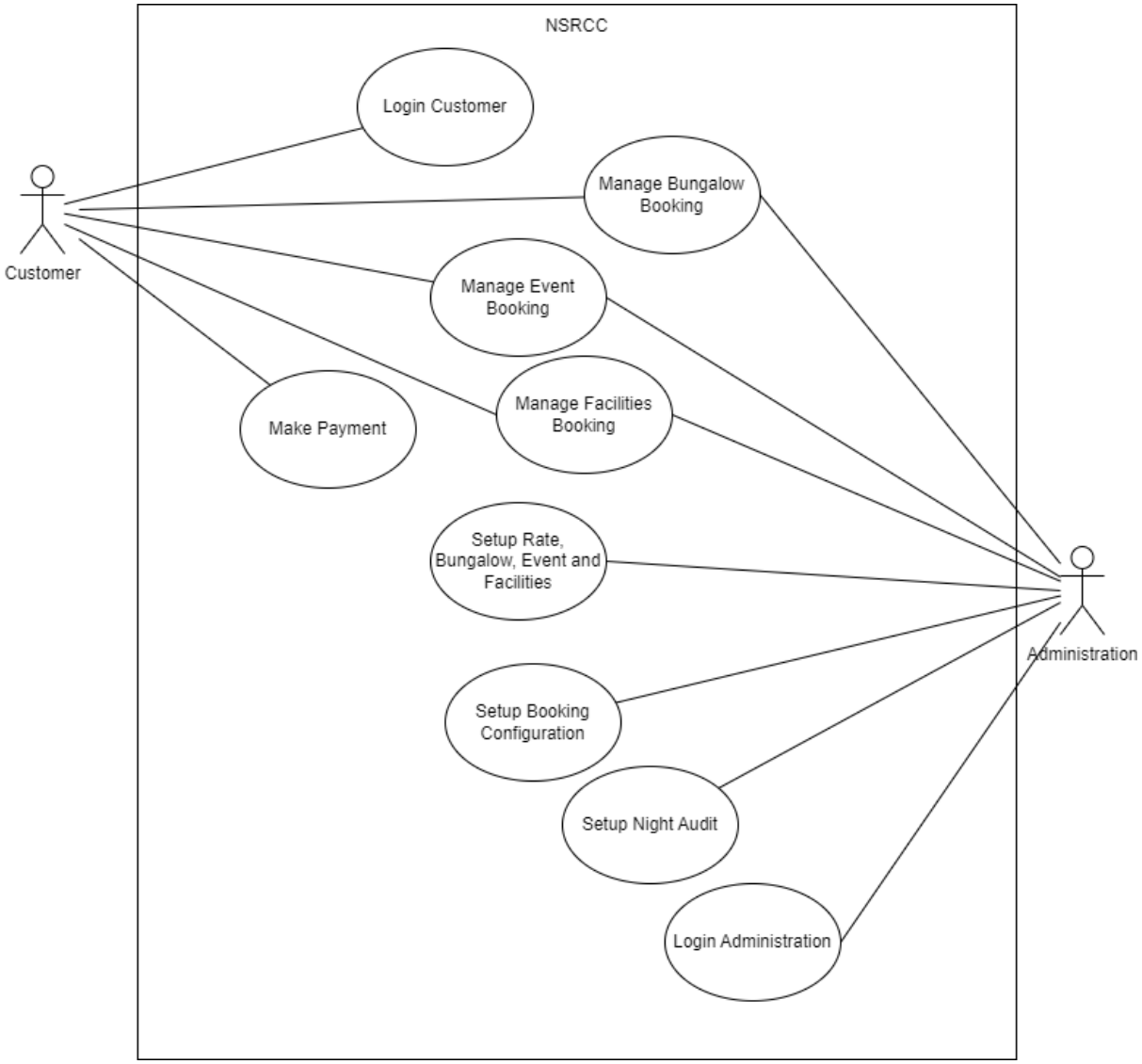

Diagram 3.2.2.1 Use Case NSRCC

Use case is used to describe how a user uses a system to accomplish a particular goal. A use case diagram consists of the system, the related use cases and actors relates these to each other to visualize of what is being described, who is is using the system and what the system and the one using want to achieve ("Use Case Diagram Tutorial" n.d.). Thus, use cases help ensure that the correct system is developed by capturing the requirements from a user's point of view. Diagram 3.2.2.1 shows a simplified version of the actual use case system since the actual one is confidential for public use. The use case diagram depicts how customer can book any bungalows or events or facilities via NSRCC based on the setup from administration. Manage bungalows, events and facilities include amendment, cancellation, no show, check in, check out and many others after booking. Setup is more on adjusting, increase or decrease, add or remove certain item or scaling in the system to fulfill business need.

After gathering all the user requirement and use cases, a module consist of main function for the system is written. The module must accommodate all use case for it to be called complete module. Module for NSRCC is shown as in diagram below.

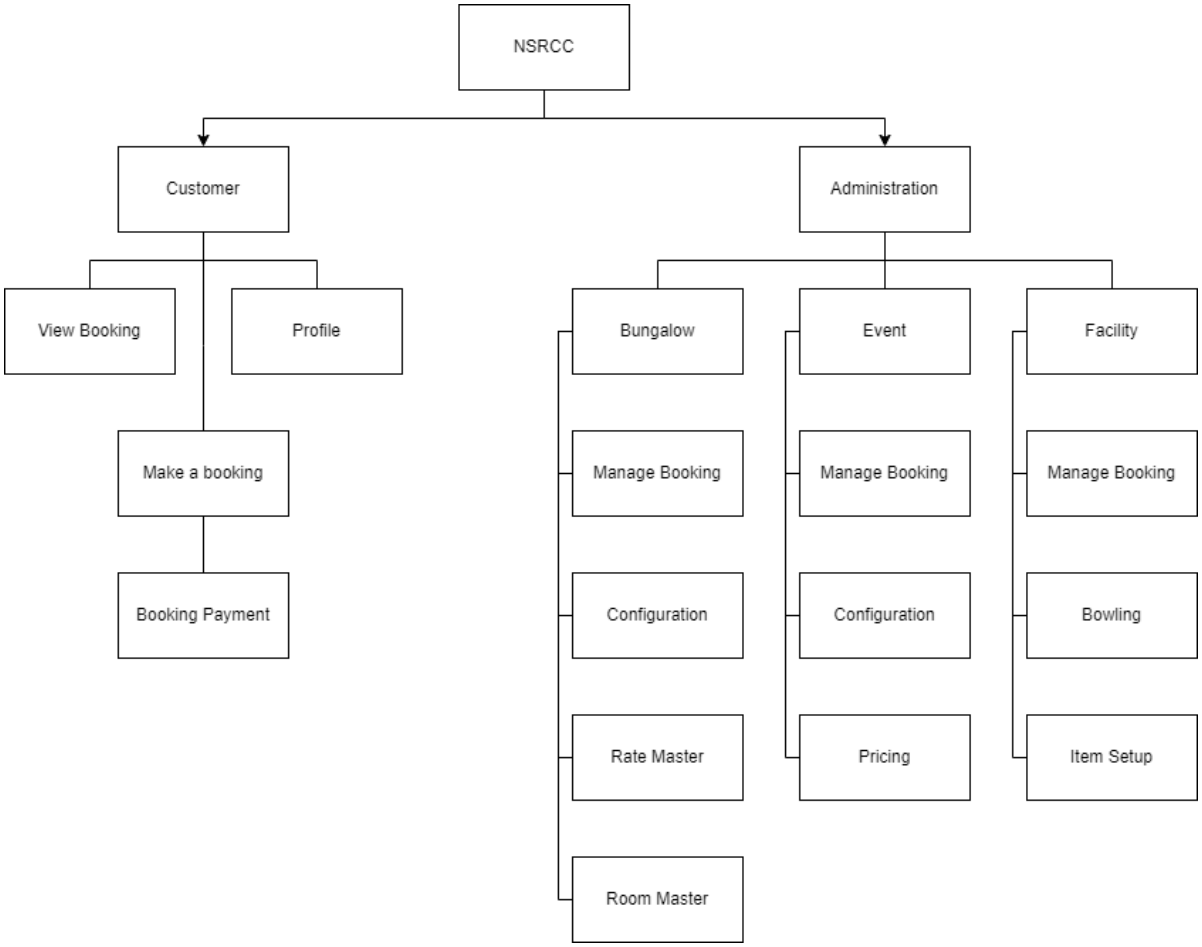

Diagram 3.2.2.2 Module NSRCC

As shown in the Diagram 3.2.2.2 above, there are mainly two user in NSRCC who is customer and administration. Customer can only setup their profile, make booking and payment and view past booking while administration has many module that is categorised to three of their main product namely Bungalow, Event and Facility.

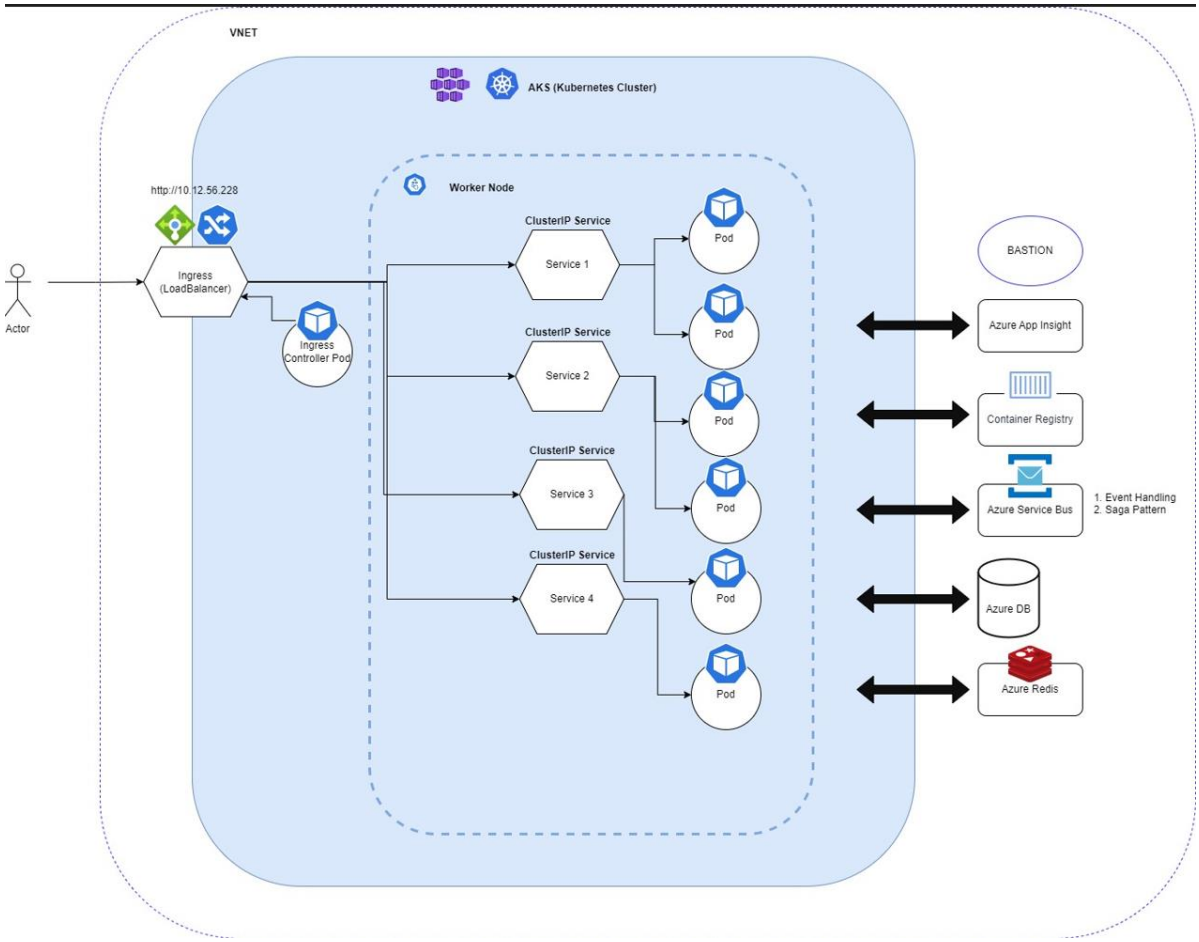

Diagram 3.2.2.3 Architectural Plan NSRCC

Software architecture is one of the important thing when developing application. The architecure will serve as a base for application, giving us basic understanding on how the high level component will work all together. Diagram 3.2.2.3 above shows an architectural plan for NSRCC. This architectural plan is based on microservice architecture where different features or tasks are split into separate respective modules/codebases which work on conjunction with each other forming large service as whole. This particular architecure facilitates easier and cleaner app maintenance, feature development, testing and deployment in comparison to monolithic architecture.

From the diagram, the outer most part, VNET stands for Virtual Network, a feature of Microsoft Azure that allows users to create isolated virtual networks within their Azure subscription. Inside of VNET is AKS (Kubernetes Cluster) stands for Azure Kubernetes Service which is a fully managed Kubernetes container orchestration service offered by Microsoft Azure. We will talk more about Kubernetes later on. From the interior part, user will access to NSRCC using Ingress (LoadBalancer). Ingress (LoadBalancer) is a type of Ingress resource. Ingress resource defines a set of routing rules that map incoming HTTP(S) traffic to Kubernetes services. It can be thought of as a Layer 7 load balancer that operates at the application layer of the OSI model. Now to use Ingress(LoadBalancer) we have Ingress Controller pod which is basically as the naming itself, serves to enables external access to services running within the cluster.

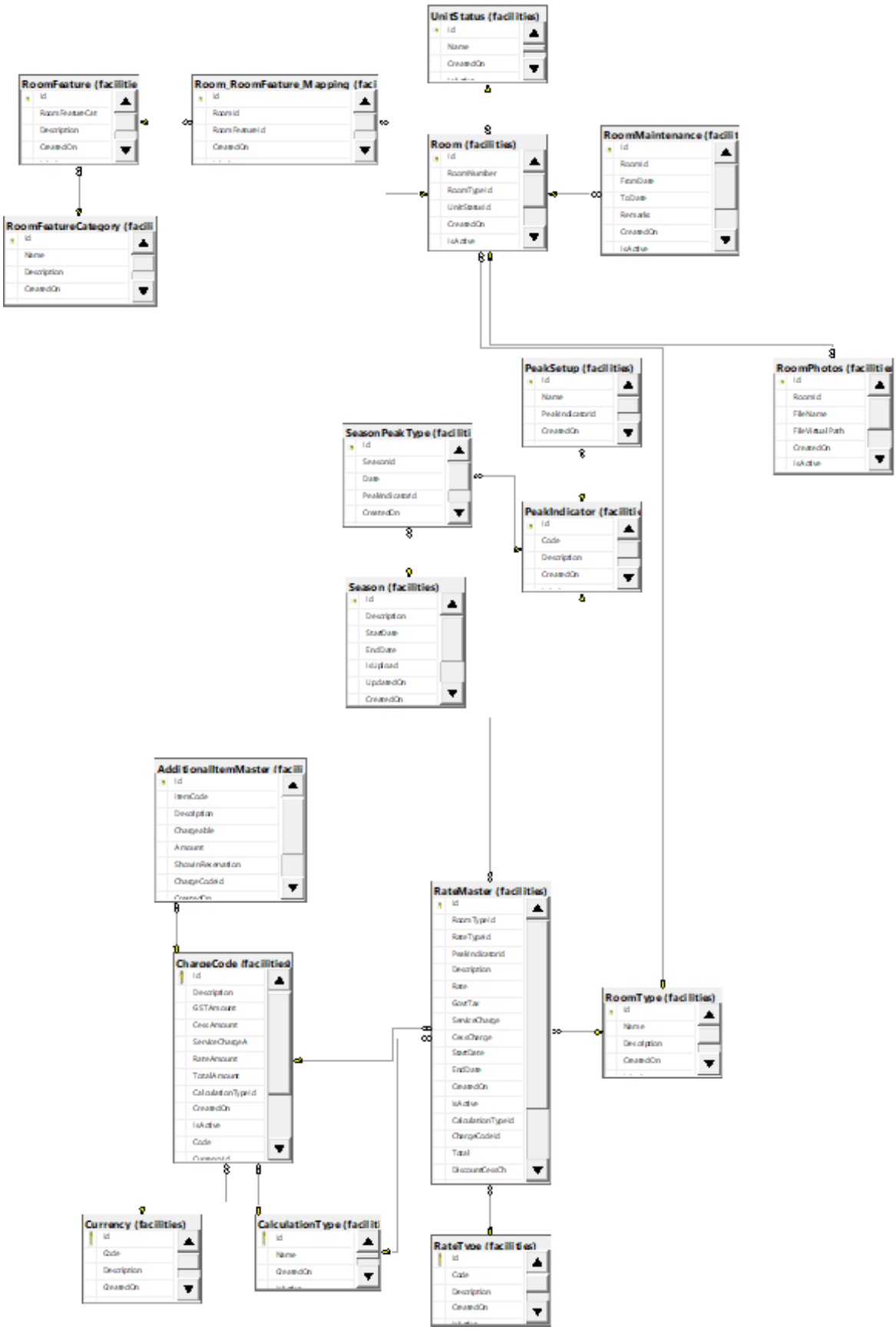

Diagram 3.2.2.4 ERD NSRCC

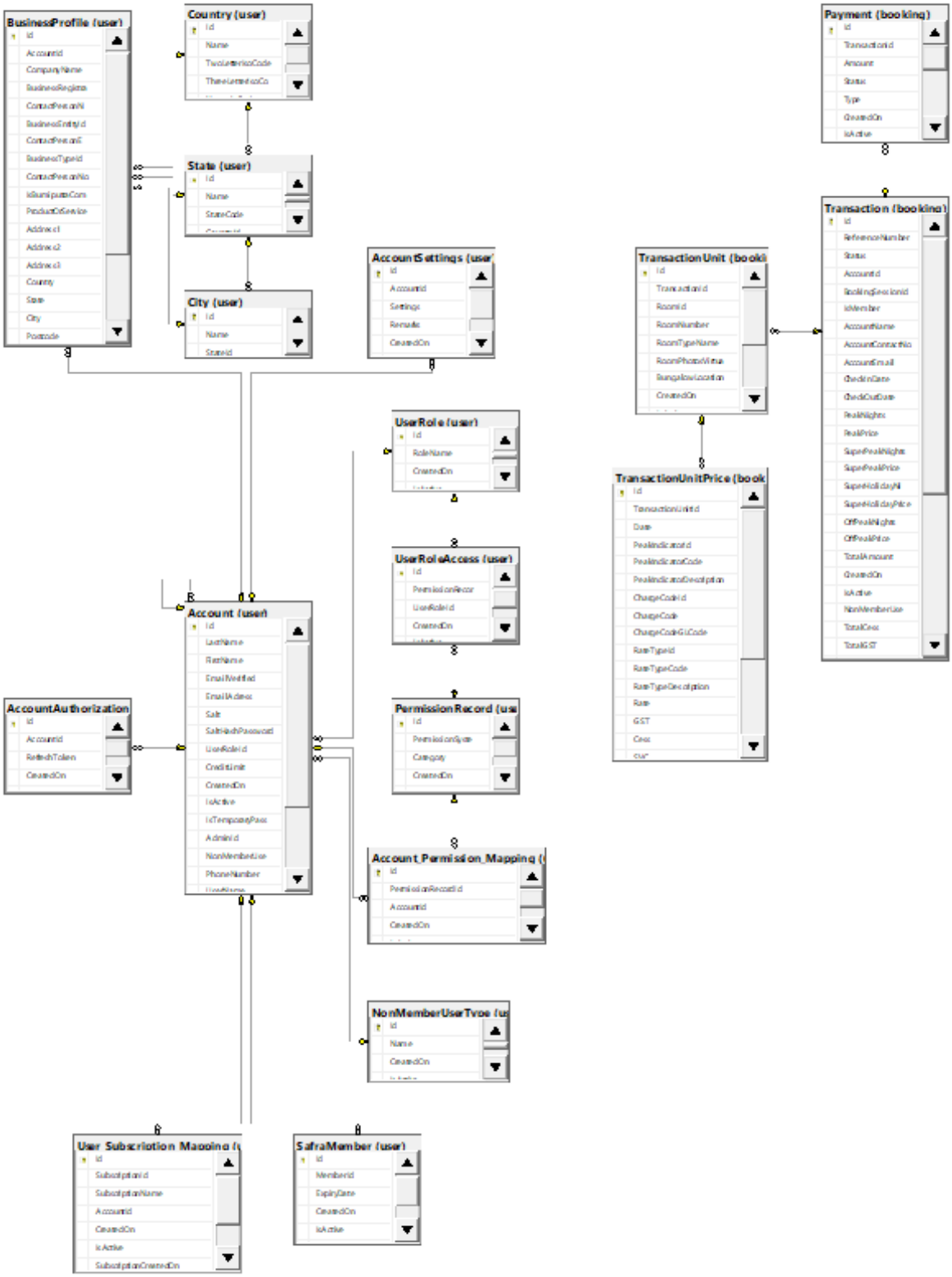

Diagram 3.2.2.5

Diagram 3.2.2.6

Diagram 3.2.2.4, Diagram 3.2.2.5 and Diagram 3.2.2.6 above shows a part of the whole Entity Relationship Diagram(ERD) for NSRCC. ERD is a graphical representation that depicts relationships among people, objects, places, concepts or events within an information technology (IT) system("What is Entity Relationship Diagram (ERD)? | Definition from TechTarget" n.d.). It shows how each table is related to other table using primary key and foreign key. Database normalization can help to create a good ERD diagram. In NSRCC, the most important entity would be Transaction(Booking) as it contain the ID of many other entity.

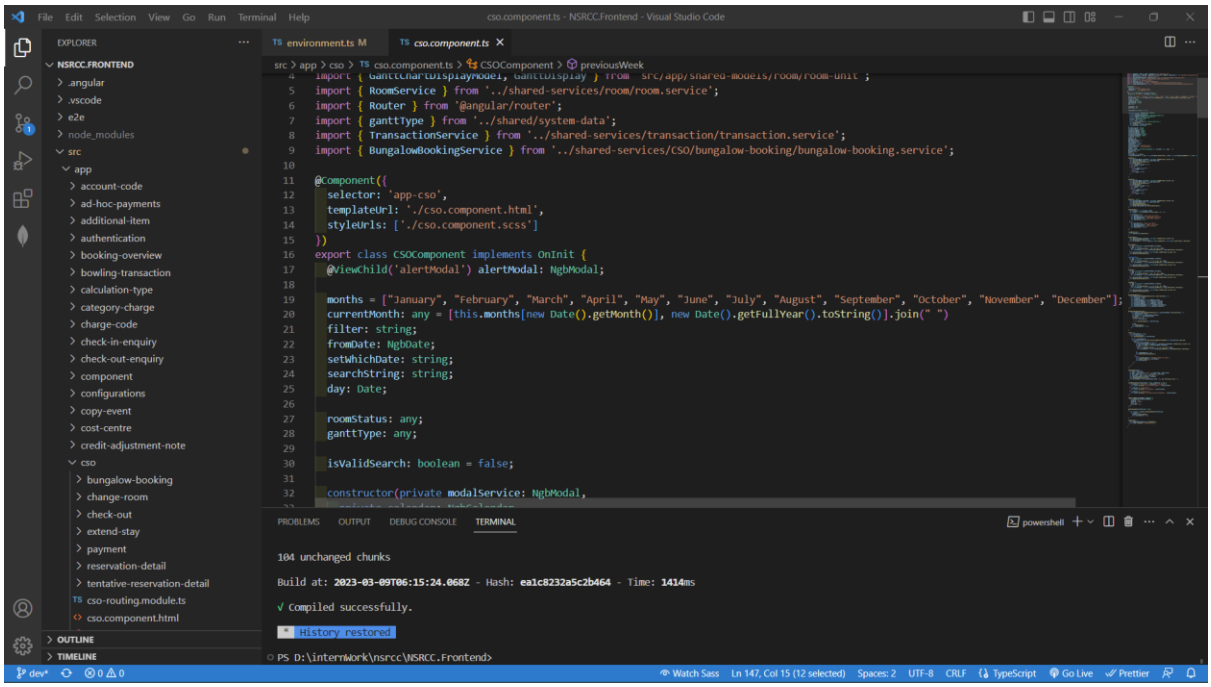

Diagram 3.2.2.7 Angular Code in Visual Studio Code

NSRCC Project is developed using Angular as the front-end and .NET 6 for the back-end. Angular is a front-end web application framework used to build single-page applications (SPAs). It is developed and maintained by Google and is written in TypeScript, a superset of JavaScript that adds features such as static typing and class-based object-oriented programming . Diagram 3.2.2.7 shows one of components used in NSRCC. In Angular, components, templates, directives and dependency injection are the core ideas to let you fully utilise the framework's benefits. Components are a building blocks that compose an application.

Templates are mainly a HTML to render the component mentioned. Directives is basically a two-way binding method which is one of the strongest keypoint for Angular. And lastly dependency injection lets you declare the dependency of your TypeScript classes without taking care of their instantiation.

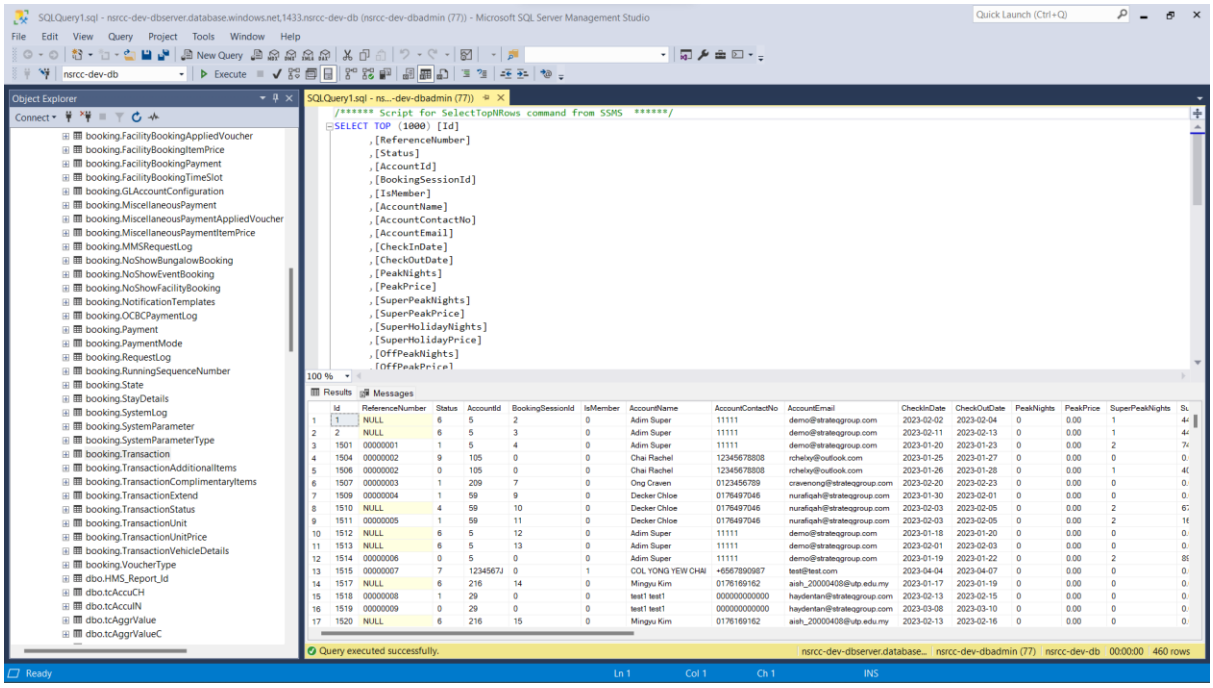

Diagram 3.2.2.8 SQL Server NSRCC

Data is retrieved from SQL Server using API call written in .NET 6. As shown in the Diagram 3.2.2.8 above, each table is created based on the ERD diagram. We are instructed to use code first approach rather than database first approach. Code first approach allows you to create database using entity classes to build MVC applications. It is suitable for a project starting from scratch and also small applications that are not data intensive (“What is the Difference Between Code First and Database First Approach in MVC - Pediaa.Com” n.d.). Benefit of code first approach is it is easier to versioning databases. Since the database schema is fully based on code models, versioning the source code is similar to versioning database. To use code first approach, you must first create your class in Models Folder. Next, add your DbContext, view and controller. Finally, use Entity Framework Core (EF Core) to add migration and update your database (“Code First Approach in Entity Framework” n.d.). Noticed here that there is Models, View and Controller resembling one of the famous software architectural pattern, MVC or Model-View-Controller. Therefore in full name, it is called Code First Approach in MVC Pattern. The versioning comes from the number of migration file being created. Since NSRCC uses Angular as the front-end, Views from MVC Pattern is not needed so it was changed to Controller-Service-Repository pattern or Repository Design pattern. Repository Design Pattern will be talk more in the following paragraph.

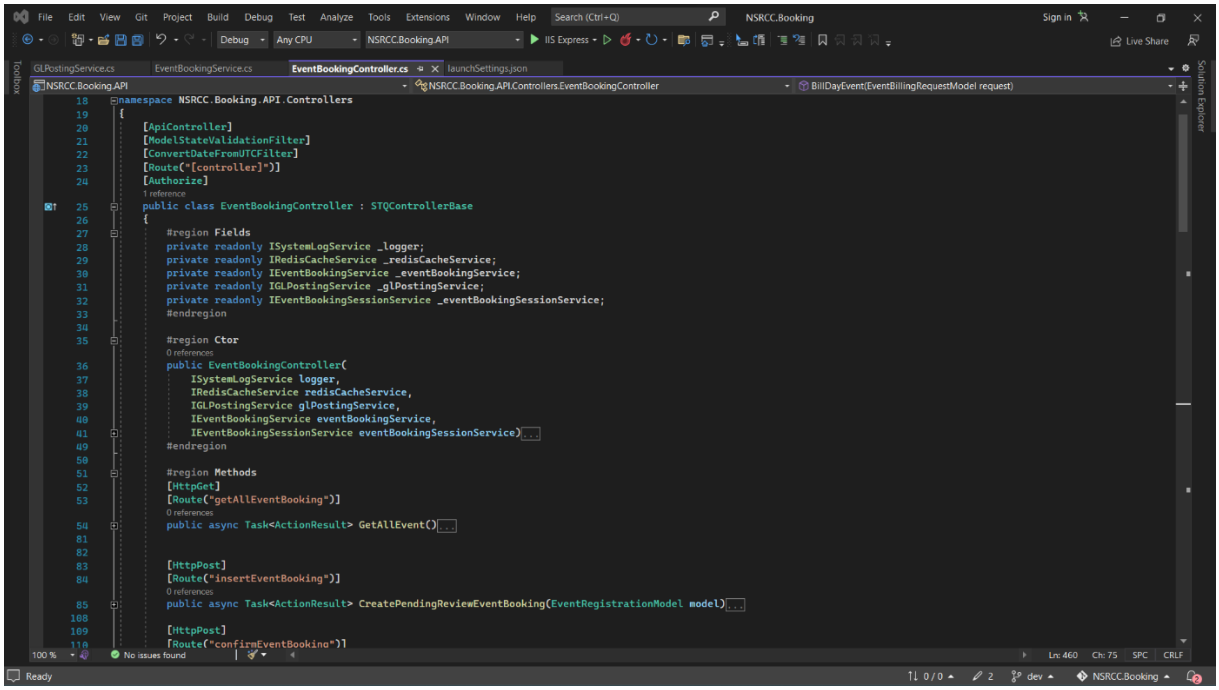

Diagram 3.2.2.9

.NET 6 is the fastest full stack web framework, which lowers compute costs if you're running in the cloud. .NET 6 and Visual Studio 2022 provide hot reload, new git tooling, intelligent code editing, robust diagnostics and testing tools, and better team collaboration(“What’s new in .NET 6 | Microsoft Learn” n.d.). Diagram 3.2.2.9 shows few API used in NSRCC written in .NET6. Repository design pattern is widely used in enterprise level application and that include NSRCC Project. The repository is used to create an abstraction layer between the data access layer and the business logic layer of an application(“How to perform Repository pattern in ASP.NET MVC?” n.d.). Implementation of repository patterns can help to abstract your application from changes in the data store and can facilitate automated unit testing. Benefit of using repository design is changes in data access logic does not affect repository logic and you can test the API call without completing user interface first. Upon retrieving data using repository, service layer acted as base of code logic to filter, calculate and many other data handling process.

3.2.3 System Implementation

After detailed planning, design and execution, NSRCC is finally ready for testing and deployment. Developer commits their coding and the codes is pushed into Dev environments and User Acceptance Testing (UAT) environment. To perform early defect detection, testing is done throughout the process of development until finish. Here, tester will access the Dev environment and run testing to avoid defect in NSRCC and it follows the user requirements.

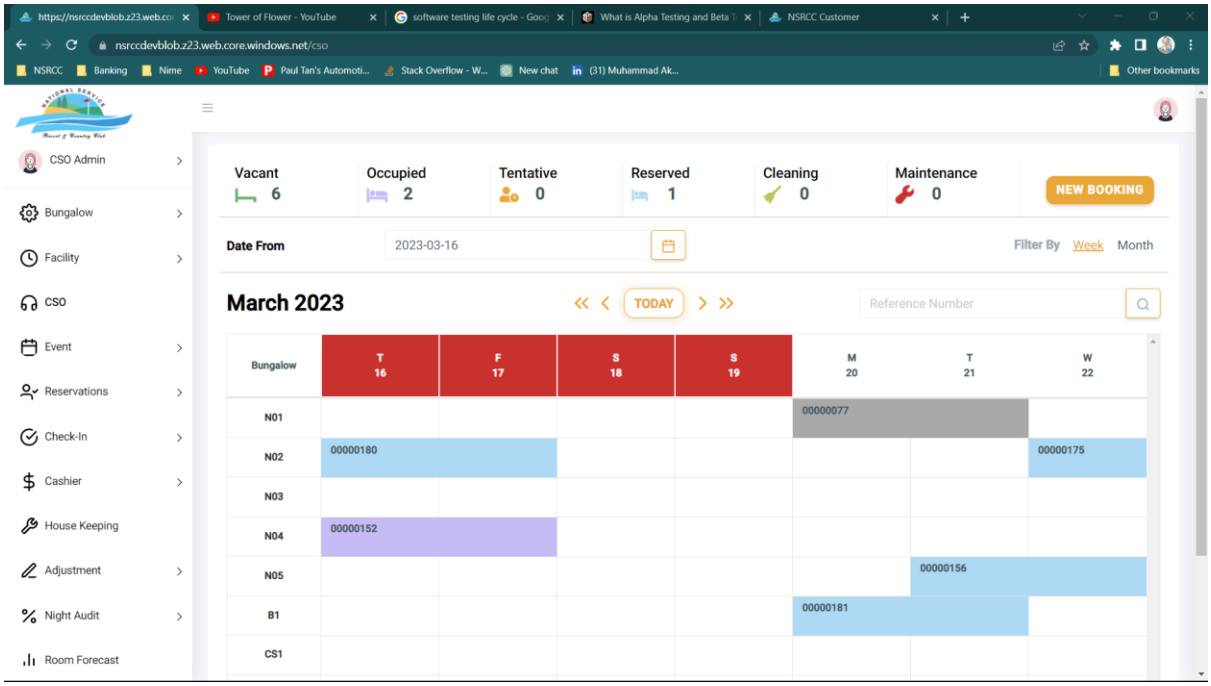

Diagram 3.2.3.1 NSRCC Administration CSO Interface

NSRCC have two websites cattered for customers and administration respectively. Diagram 3.2.3.1 is a complete functioning NSRCC Administration page with a side vertical bar of more than 50 menu items. The CSO page is to manage alll bungalow booking based on calendar. Bungalow consist of around 30 different pages for setup Bungalow-related module. Facility has about 16 different pages for setup Facilities-related module and lastly Event will have 19 different pages to setup Event-related module. There are also other function that will not be explained as it is too long for this report. Overall, NSRCC Administration is a huge success and has been completely developed.

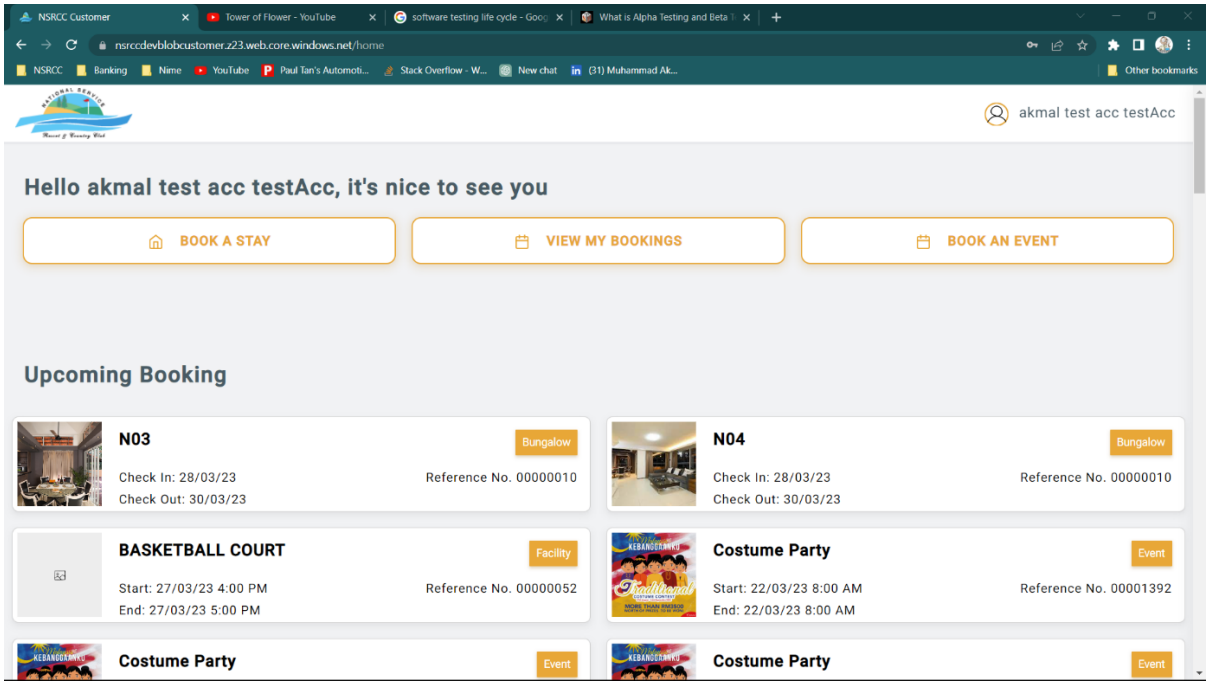

Diagram 3.2.3.2 NSRCC Customer Homepage User Interface.

Diagram 3.2.3.2 shows a completely developed web page for customer of NSRCC. Customers has only a few modules including to book bungalow, event and facilities. After booking the can proceed to payment and get their payment confirmation. Once they have completely make a booking, List of booked product is shown as in the diagram above. Customer can click on them to get more detail about the status of their booking. Customer can also setup their profile in the top right corner of the user interface. Profile includes name, membership, contact number, email address and password. In conclusion, NSRCC Customer site is well developed and ready for testing.

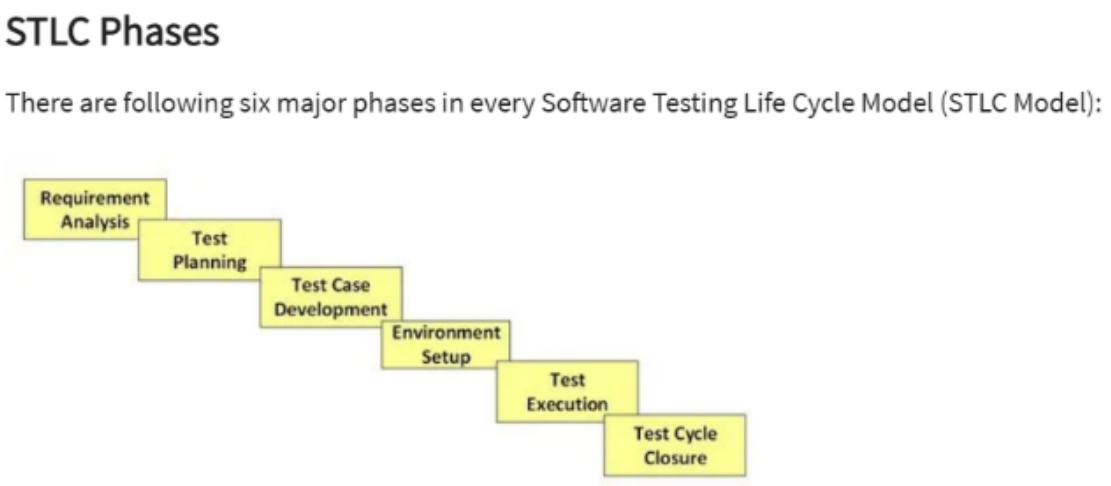

Diagram 3.2.3.3 STLC Phases

NSRCC strictly follow Software Testing Life Cycle (STLC) for every testing. Diagram 3.2.3.3 shown a brief display of overall STLC. There are many types of testing including Testing for Functionality, Testing Web APIs, Testing Database, Regression Testing, Testing for Cross Compatibility, Testing UI and Visual Elements, Testing Web Security and lastly Testing Performance and Loading Speed. From all the type of testing, only Testing Functionality will be explained. Under Testing Functionality, there is Unit Testing, Smoke Testing, Build Verification Testing, Confidence Testing, Sanity Testing and Regression Testing. Of all that, only Unit Testing and Regression Testing is done throughout the whole project.

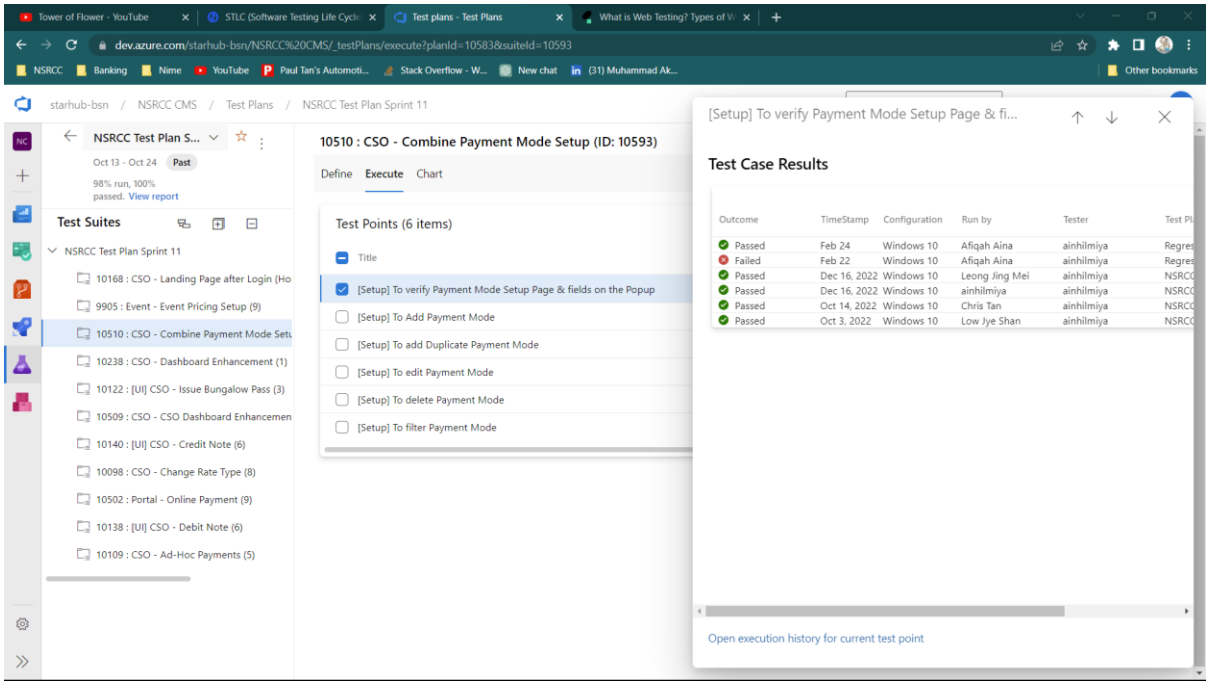

Diagram 3.2.3.4 Test Case 10510

Unit Testing is a functional testing to validates small and individual areas of the application in the early stages of development so that defect and bugs can be detected early on. Diagram 3.2.3.4 shows one of the test cases for Sprint 11. On the left side is the list of all test cases in Sprint 11. In the middle, a list of test points for a test cases that need to be passed. On the right side is the test execution history done by tester and developer. Person who running the test cases can click on the list to get the step for testing. Test is recorded as Fail if only when there is unexpeted output or display and Passed vice versa. You cannot cheat the test cases as there need to put screenshot on every expected output and it is very unethical to do so.

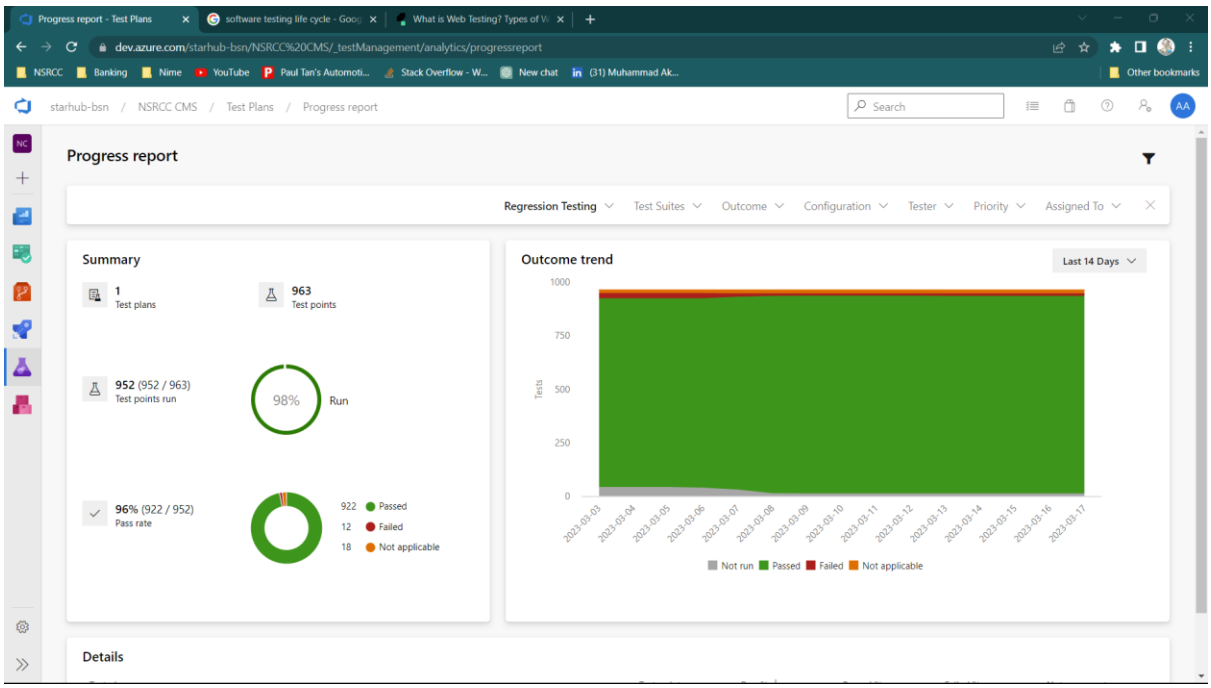

Diagram 3.2.3.5 Regression Testing Progress Report

Regression Testing is to retest a selective list of testcases to identify areas that reacts more severe to changes and ensure existing features stay functional. Regression Testing is done afer whole NSRCC has been developed and it is done both in Dev Environment and UAT Environment. Diagram 3.2.3.5 shows a progress report for regression testing in NSRCC. The Passed rate is around 96% showing that most test cases Passed successfully might be due to Unit Testing done earlier. The more the number of testing, the faster defect is detected and treated.

4. RESULTS AND DISCUSSION

NSRCC is a web application project for online booking in Singapore. Project goes through development for more than six months and now is successfully deployed to the client. By using Agile development pattern, requirement is revised many times with PO and every issue is cleared throughout the process. Azure DevOps works well as a very useful tool for managing agile development pattern. With Passed rate of more than 90%, NSRCC is sure to work well for daily use. Angular and .NET Frameworks provides a hefty amount of help to reduce the workload on to every team member. Our stakeholder is very satisfied with the end product of our development. Overall, NSRCC is successfully a fully functional web application project for booking bungalow, event and facilities that can cater high traffic transaction and can be operated on any devices that support common browser.

5. CONCLUSION

Internship programme in Strateq Group is a great programme to enhance a programmer's skill especially in Angular and .NET Frameworks. Interns is taught on how to work as a team, good habit of coding and much other software development knowledge. Interns is now more acquainted with experience when going through Agile software development method and become familiarised with job as a full-stack developer. In conclusion, Strateq Group internship programme provides a whole lot of experience and knowledge to participants, and it is very encouraged to any student to join this programme.

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