

# ARCHITECTING THE NS PORTAL FOR EXCELLENT USER EXPERIENCE

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## ABSTRACT

The National Service (NS) Portal is the main public-facing service delivery touch-point for the Ministry of Defence (MINDEF) and the Ministry of Home Affairs' NS community. It allows users to carry out over 400 unique business transactions and access information from 30 MINDEF and Singapore Armed Forces internet websites. This article describes the approach and considerations in revamping the NS Portal to deliver an excellent user experience. It was delivered based on an architecture that facilitates agility in integrating new capabilities downstream readily, a first among all of the Government's transactional portals.

*Keywords:* user experience, architecture, portal

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## INTRODUCTION

The National Service (NS) community is increasingly tech-savvy, with high expectations of user experience for digital services shaped by IT consumerisation. As the main public-facing service delivery touch-point for the Ministry of Defence (MINDEF) and the Ministry of Home Affairs' NS community and the public, the NS Portal faces unique challenges in delivering excellent user experiences to meet their growing demands. To meet these challenges, the solution adopted for the portal architecture has to be easily scalable and adaptable to allow it to be integrated with new technologies, as well as match the escalating pace at which IT solutions are expected to be delivered.

When the opportunity came to redevelop the NS Portal, the DSTA team focused its efforts on two key areas, namely: improve the user experience, and build an agile architecture that can adapt new changes easily.

This article describes the NS Portal user experience (UX) design and architecting journey towards a future-ready portal that is agile in adapting quickly to future channels such as

conversational user interfaces and Internet-of-Things (IoT)-based connected devices. This would ensure that the end user experience in interacting with the NS Portal is sustained.

## NS PORTAL UX DESIGN JOURNEY

The success of the NS Portal's UX design requires effort to optimise the skills and expertise of a diverse team of engineers, designers, analysts, researchers and architects. To achieve this synergy and align the development with DSTA's drive towards Design Innovation that focuses on user-centricity, the team adopted the "Double Diamond" process.

The "Double Diamond" process<sup>1</sup> (see Figure 1) maps the divergent and convergent stages of the design process towards achieving user-centric outcomes. The team starts by discovering information and gathering insights in the problem space (divergent Discover Phase), before proceeding to make sense of the uncovered possibilities and narrowing down the areas to focus on (convergent Define Phase). Next, the team explores potential solutions and validates options to find the best way to succeed (divergent Develop Phase). Finally, exploration leads to engineering solutions which are optimised

and delivered to gather feedback in an iterative process of continual improvement to the UX design (convergent Deliver Phase).

Adopting the “Double Diamond” approach allowed the team to maintain a user-centric focus towards the project implementation. Through this approach, design artefacts were created to address real user needs, tested with real users and multiple avenues for innovation were explored. Every solution and concept was validated with real users in usability testing sessions and surveys that have helped to shape the NS Portal towards an ideal product fit for the NS community.

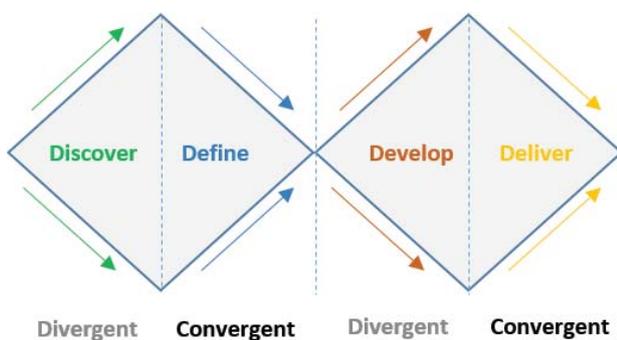


Figure 1. “Double Diamond” design process

## Discover Phase

The Discover Phase focused on identifying user needs. The needs identified in this phase set the stage for the conceptualisation of the UX for the NS Portal. The team conducted interviews with senior leadership to seek guidance on the desired outcomes for the portal's UX design, which helped to formulate key questions used to engage the end users. This drove the focus of the Discover Phase. The key questions for end user engagement and desired outcomes for the UX design elicited are summarised in Figure 2.

The team then set out to uncover the needs of all end user groups with respect to the desired outcomes by adopting a user discovery approach that involved six design activities (see Figure 3). While these activities involved vastly different parties and tasks, the common theme was the team’s commitment to reach out to users of all levels, and ensure that no stones were left unturned.

Through this approach, the team identified four main categories of the end users’ needs, namely: transactional, informational, connectedness and aspirational. These were then analysed in the Define Phase.

Key Questions		Outcomes
What is the current attitude towards NS?	<ul style="list-style-type: none"> <li>• Big picture impact vs. individual level</li> <li>• NS benefits and drawbacks</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Stakeholder engagement and needs</b> <ul style="list-style-type: none"> <li>– Target level of engagement and satisfaction</li> <li>– Motivations for NS, and expectation of returns from service</li> <li>– Understanding of big picture and individual role in serving NS</li> <li>– Drivers of needs and expectations</li> </ul> </li> <li>• <b>Role of NS portal and current gaps</b> <ul style="list-style-type: none"> <li>– Value proposition of NS portal</li> <li>– Key services sought/provided</li> <li>– Prioritisation of existing services across segments</li> <li>– Identification of new opportunities to address major gaps</li> <li>– Rationalisation or redefinition of overlapping services</li> </ul> </li> </ul>
What are users' needs and expectations from NS Portal?	<ul style="list-style-type: none"> <li>• Motivations for NS</li> <li>• Broader definition of needs: Willingness and Aptitude</li> <li>• Unconstrained compilation of viewpoints and vision</li> </ul>	
What gaps exist, and what roles should NS Portal play?	<ul style="list-style-type: none"> <li>• NS Portal specific expectations</li> <li>• Usability, content, functionalities, visual style</li> <li>• Relevance and value of potential concepts/initiatives</li> </ul>	

Figure 2. Key questions and desired outcomes from the Discover Phase

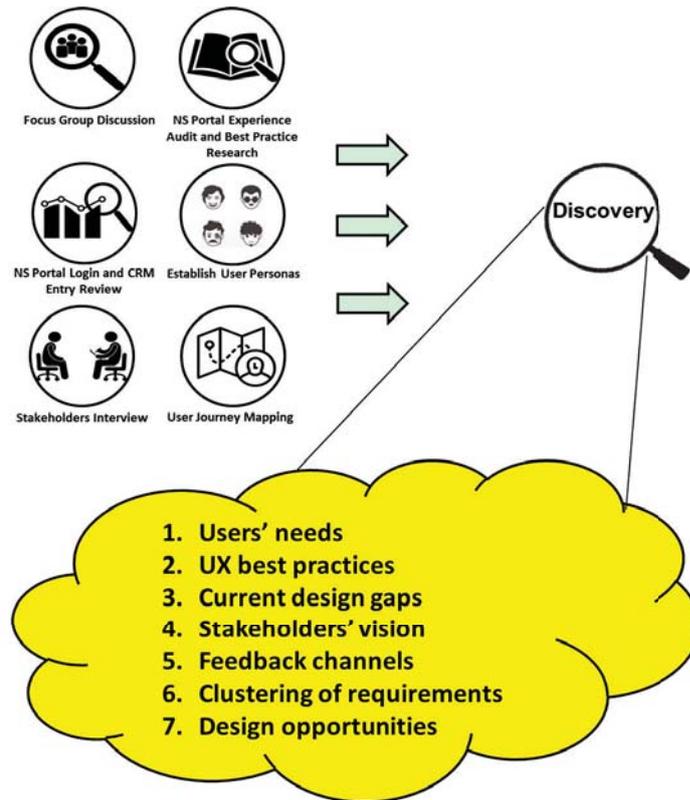


Figure 3. User discovery approach

## Define Phase

The Define Phase focused on analysing the findings from the Discover Phase and synthesising them into actionable tasks to achieve a streamlined and efficient UX for the NS Portal. In the analysis, the transactional aspect of NS Portal bore a higher priority (see Figure 4), which greatly influenced the NS Portal's UX design to be more focused on improving the delivery of transactions rather than information.

## Develop Phase

The Develop Phase focused on iterative prototyping of solutions and concepts to address the end users' transactional needs in the NS Portal. Four key design concepts were developed in this phase to anchor the NS Portal's UX design.

### *Personalised Dashboard*

The design intent of the personalised dashboard laid in proactive notifications of transactions that are relevant to the user, arranged by order of urgency or importance to aid the end users in prioritising their attention. Relevant personalised

data are displayed prominently to facilitate better and quicker decisions for the end user. Figure 5 shows the conceptualised design for the personalised dashboard.

### *Card-based User Interface Design*

A card-based design is a user interface (UI) design pattern that groups related information in a flexible-sized container visually resembling a playing card. It was pioneered by Pinterest and adopted for implementation by major websites including Google, Twitter, Facebook and Instagram. To address the need to manage the myriads of information and transactions on the NS Portal elegantly, a card-based design that allows users to scan through short bursts of digestible information to find what they need quickly was developed. Furthermore, with the growing trend of mobile web browsing, a card-based UI allows easy manoeuvres with the thumb, with intuitive physics in flipping and swiping cards on the mobile platform. Lastly, cards allow the ease of incorporating dynamic interactions whenever a user is required to act on urgent tasks. These were all contributing factors to the card-based UI design being the ideal fit for the NS Portal's personalised dashboard (see Figure 5).

## NS Portal User Needs

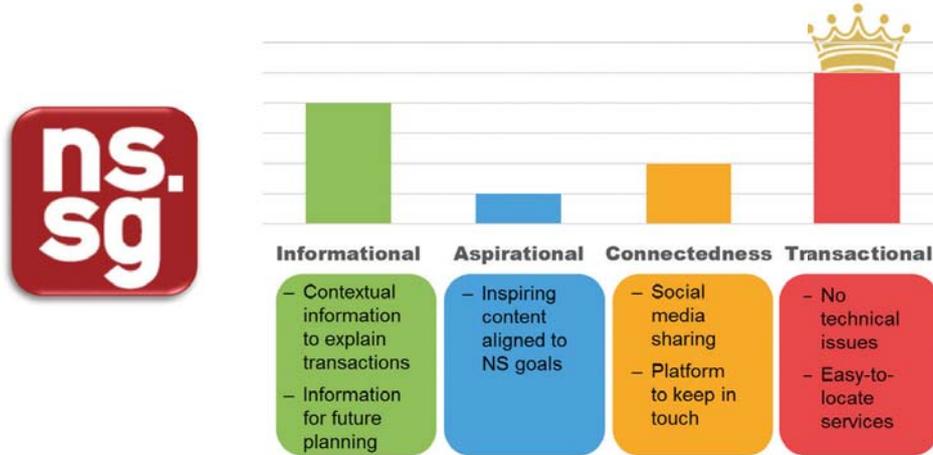


Figure 4. Categories of user needs in the NS Portal

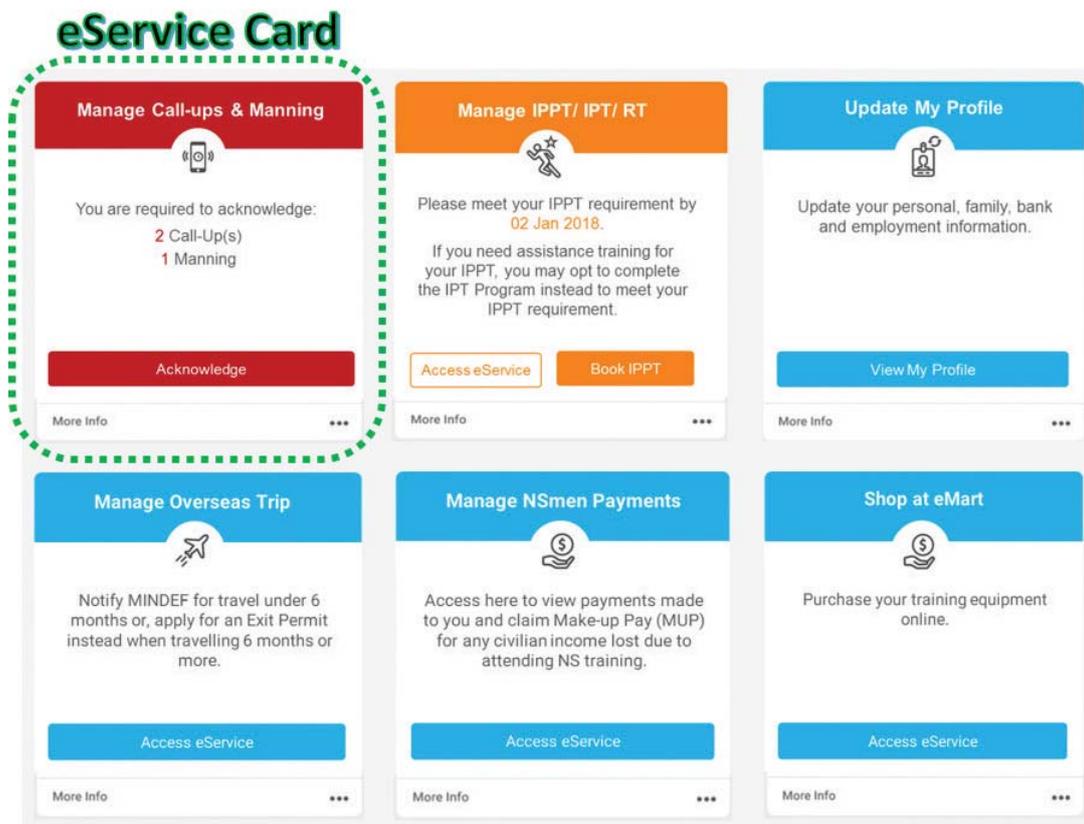


Figure 5. Personalised dashboard concept with card-based UI design

## Contextual Support

The concept of contextual support was about providing information to the user at the right place and time of a transaction, to assist him through his interactions with the NS Portal. For example, MINDEF/SAF-specific terminologies such as Physical Employment Standards and Operationally Ready National Service was explained via contextual assistance to alleviate the anxiety that users face when they encounter a foreign term, and save time and effort otherwise needed to search for its meaning.

## Responsive Web Design

Responsive Web Design (RWD) is the practice of building a website suitable for every device and every screen size. The adoption of RWD allowed the NS Portal to maintain UX consistency across all devices. This also ensured that the NS Portal is able to adapt to the growing trend of using mobile phones and tablets for transactions on the go.

## Deliver Phase

The Deliver Phase focused on producing a workable prototype for usability testing to gather real end user feedback, before proceeding to actual development. After multiple design iterations to refine the design concepts in the Develop Phase, a prototype of the NS Portal's UX design was conceived at the start of the Deliver Phase. This prototype was then subjected to two rounds of usability testing to better understand the interaction of the prototype with the real end users (see Figure 6).

Each usability testing session was conducted using two rooms with inter-connectivity. One of the rooms was used for the actual testing with the end user, with a moderator to facilitate the testing process. All testing sessions were recorded for

analysis purposes. The other room housed a team of observers who noted down the behavioural insights of the end user as they interacted with the prototype. With RWD being one of the design concepts, user experience was also tested using a mobile prototype. An overview of the set-up is shown in Figure 7.

The team used a usability testing software to capture parameters such as time on task, task completion and error rates, while recording the user's interaction with the prototype, facial expressions and dialogue.

In particular, an eye-tracking tool was also deployed to observe and record the user's eye movements. Of special interest were points of fixation, which are areas where the user's gaze stops moving to process what they had seen. A heat map of this eye movement was formed at the end of the session, and potential usability issues were sieved out by combining the heat map and the parameters captured by the usability testing software. For example, if the users were fixated on the correct button yet had poor task completion rates, that indicated that they might not have understood the button's purpose, causing them to linger and hesitate. The team would then analyse this information and put in design refinements such as adding tool tips to the button or re-positioning the button to improve the task completion rate.

This usability testing allowed the team to further refine the NS Portal's UX design with key improvements such as the positioning of UI elements, taxonomy of eServices, presentation of information and accentuation of screens.

With the conclusion of the usability testing, the current iteration of the NS Portal incorporated the final design refinements garnered from the usability test and reached a stage where the design was ready for development. To realise the full vision of the UX design, a sound back-end technical architecture also had to be in place.

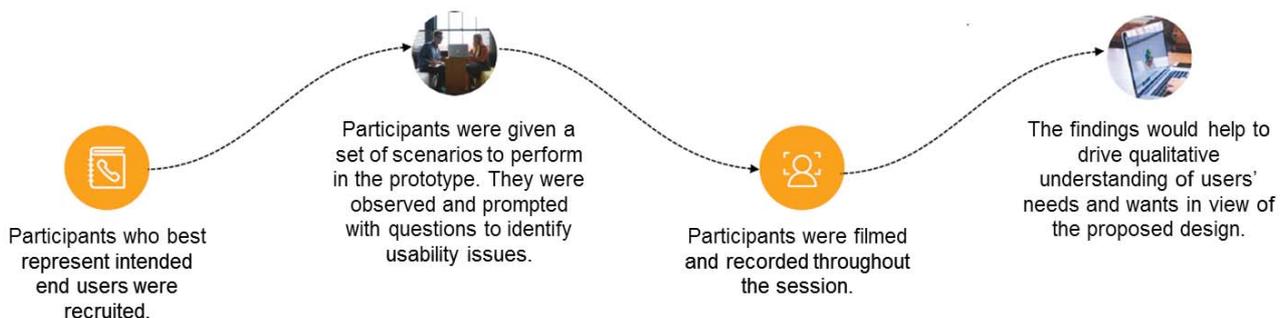


Figure 6. Usability testing flow

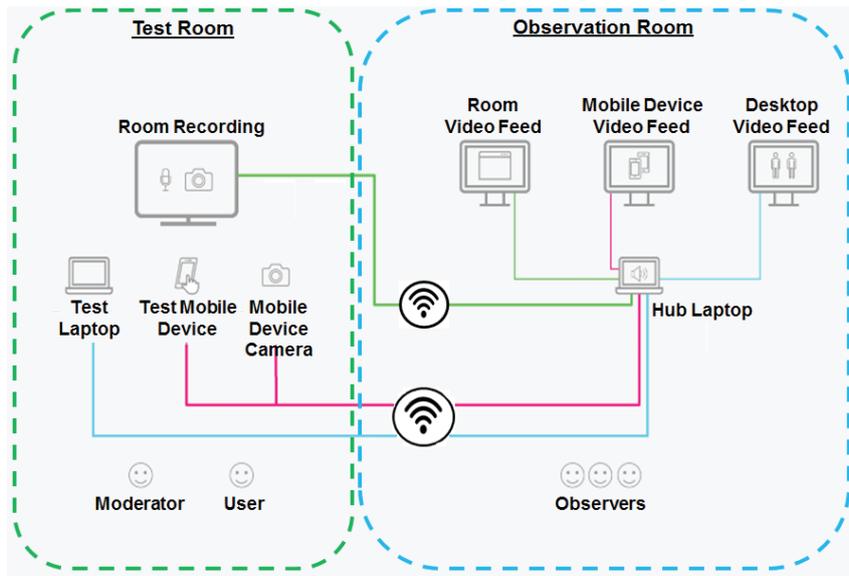


Figure 7. Usability testing set-up

## NS PORTAL ARCHITECTURE

To achieve an integrated solution which fulfils the UX design and remains agile and flexible to future integrations of new capabilities and services to enrich overall digital experience, the NS Portal adopted a Web-Oriented Architecture (WOA). In addition to the WOA, a reusable WOA design framework was also developed to standardise and package modular functions into shareable services from back-end systems to allow quick mash-up of new front-end capabilities. The NS Portal maintains the repository of these services for new eServices to enrich the capabilities offered. Figure 8 shows the NS Portal WOA.

The following are the key features of the architecture:

### Channel Agnostic Architecture

A traditional portal architecture typically requires a single set of codes to be developed for each channel of access. For example, separate sets of application codes, which include both back-end application logic and front-end presentation layer, will need to be maintained to support web and mobile channels. With WOA, which decouples the application logic and presentation layer, only a single set of application logic needs to be maintained and reused by different channels of presentation, including both web and mobile.

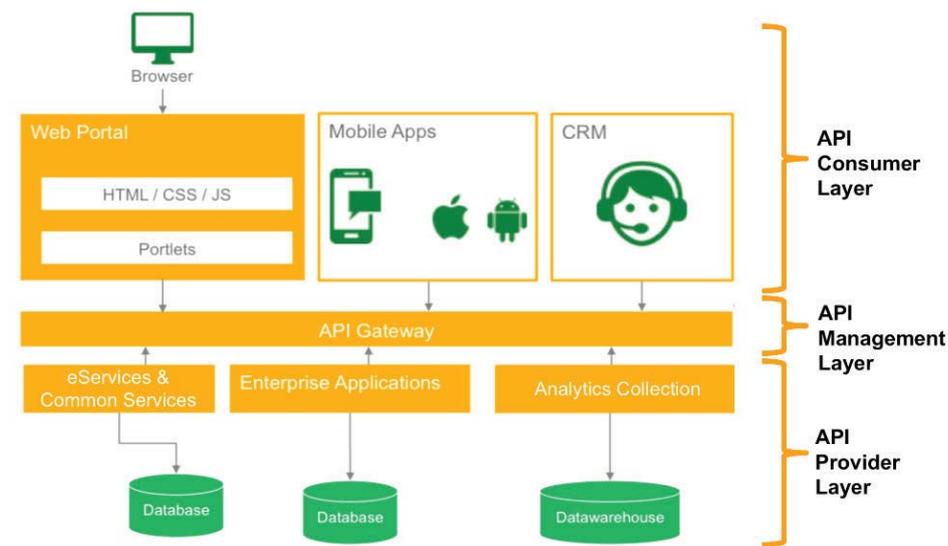


Figure 8. The NS Portal's Web-Oriented Architecture

## Façade Design Pattern – Decoupling the Presentation and Business Layers

The WOA uses a façade design pattern. Façade design pattern connects the codes written for applications which perform specific tasks such as acknowledging call-up, acknowledging manning and applying deferment to one or more independent front-end presentation which can mash up one or more tasks for these applications to provide different services to the end user. This shields the complexities of the system from the front-end presentation, providing consumers with a simpler interface to access the various services. This design pattern promotes services reuse, and is key to enabling the rapid reassembling of new front-end capabilities through a mash-up of reusable back-end services. An illustration of this mash-up is shown in Figure 9.

## Fostering an Open Architecture

The WOA is an open platform enabling a multi-vendor, multi-technology environment without requiring any pre-assumption on which technology to adopt. This approach allows more technologies to be considered when the NS Portal deploys new apps or services in the future, without precluding options and technologies due to vendor lock-ins. In addition, the main technologies and protocol adopted in NS Portal WOA – REST, SOAP, XML, JSON, OAuth, HTML 5, CSS 3.0, JavaScript, AJAX and PhoneGap – are all open-source standards. While certain commercial components were also used, the architecture and design principles allow NS Portal to easily adopt other technologies (e.g. jQuery Mobile, or native mobile apps) should a need arise in the future.

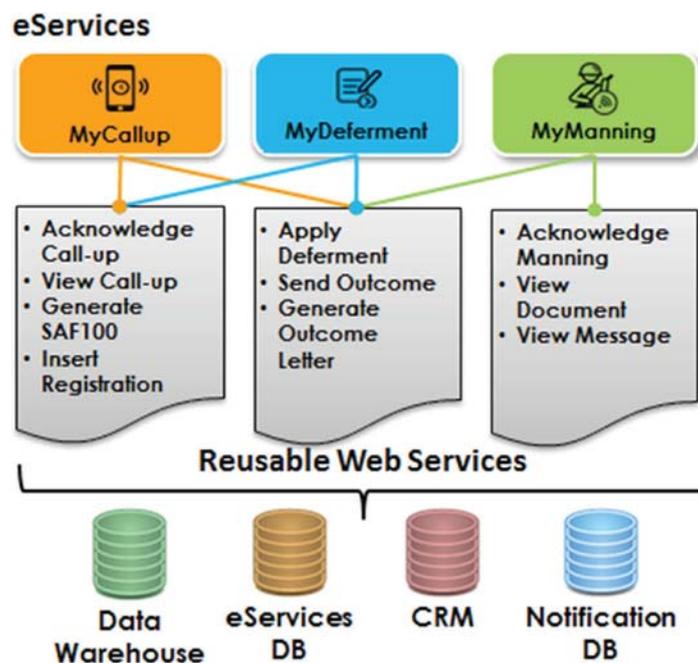


Figure 9. Mash-up of reusable web services

An Application Programming Interface (API) gateway acts as the façade, which manages the connectivity between the application codes and front-end presentation. It also enables the enforcement of lightweight orchestration, channel adaptation, security and analytics. The API gateway also facilitates more rapid development and testing, as it can simulate expected requests and responses between the application and presentation tiers, thus removing the timeline dependencies in development and testing of the codes at both ends.

The establishment of this architecture was the starting point to realise the NS Portal UX design. This architecture will also provide the flexibility to integrate the portal with new technology such as conversational platforms and virtual assistants with ease.

## LESSONS LEARNT

Several useful lessons were learnt by the DSTA Project Management Team through the NS Portal UX development journey.

### Keeping an Open Mind

Keeping an open mind throughout the UX design journey, in particular during the Discover Phase, was key to allowing a broad range of ideas and influences to be collected. It was also necessary to think out of the box and push boundaries to uncover new solutions to overcome challenges.

Extending this approach to the stakeholders helped remove the constraints of the old designs, and made them more receptive to the new designs which were more aligned to the end users' requirements and expectations.

### Prototyping Helps UX Discussions

UX discussions can be time consuming as design concepts can be abstract and hard for users to visualise and comment on the spot. Having a prototype showcases the expected user interface and navigation flows, which better facilitates discussions and refinements of the design. This approach allowed designs to be validated with the users more effectively, reducing the risk of delivering a UX design that fell short of user expectations.

### Provisioning of Guidelines is Key to Align to Architecture Standards

While the NS Portal advocates the use of WOA and common components to aid eServices in the quick adaptation and alignment with new architecture standards, there were challenges faced in the actual adoption. This was due to different coding practices and varied vendor proficiency across teams working on the different eServices in the portal. The provision of a set of guidelines by the NS Portal team, with relevant sample codes helped to accelerate the eService vendors' understanding and development of codes in the new architecture. It also governs a consistent way of coding across all eServices for improved code maintainability.

This is however not just a one-off effort. To ensure sustenance of the UX design and WOA, a NS Portal design council has also been set up to govern and control all design and technical enhancement of existing and new eServices to ensure optimal user experience is provided at all times.

## CONCLUSION

This article highlighted the UX design process that the NS Portal has gone through to deliver a user-centric UX to the end users, as well as the architecture adopted, which provides agility to deliver new or added capabilities quickly to the end users to enrich their digital experience. WOA has also made the NS Portal future-ready, allowing it to adopt new channels – including smart watches and smart televisions – easily and eased the integration with new technologies such as IoT. In the implementation of the NS Portal UX design and architecture, the team identified several learning points that can serve as a reference for subsequent UX-related projects.

## ACKNOWLEDGEMENTS

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## ENDNOTES

- <sup>1</sup> Created by the British Design Council, the “Double Diamond” process describe the modes of thinking designers adopt towards a design problem.

## BIOGRAPHY



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**LOO King Wee Joseph** is a Principal Engineer (Enterprise IT). He is currently the technical lead for portal capabilities implementation, and is responsible for the design and implementation of the Web-Oriented Architecture and portal common services. Joseph has obtained certification in Project Management from the Singapore Computer Society and is a HP Certified IT Professional. Joseph graduated from NTU with a Bachelor of Engineering (Electrical and Electronic Engineering) degree in 1999.