

ENTERPRISE ARCHITECTURE, DESIGN THINKING AND AGILE DEVELOPMENT – NEW STRATEGIES FOR LARGE-SCALE ENTERPRISE IT PROJECTS

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ABSTRACT

Corporate IT departments in many large organisations face two key challenges in implementing large-scale enterprise IT solutions – how to be more agile and responsive in an increasingly volatile, uncertain, complex and ambiguous environment as well as how to handle the rising expectations for well-designed and user-centric IT solutions.

This article outlines how DSTA has begun evolving its Enterprise Architecture practices by integrating them with Design Thinking and Agile Development to better manage large-scale enterprise IT projects. This article also shares insights into the use of this approach during the development of LEARNet Portal 2.0, the learning management platform for the Ministry of Defence and the Singapore Armed Forces, and how it has shortened delivery time and enhanced user experience.

Keywords: enterprise IT, enterprise architecture, design thinking, agile development, user centricity

INTRODUCTION

Large-scale enterprise IT projects are complex undertakings. Such complexity is inevitable in big organisations due to the sheer number of distinct business units and the need to meet the expectations of multiple stakeholders who may have differing goals and needs. This issue is further compounded by demands for greater cross-functional integration across organisational business units and processes as well as other IT systems.

Amid such complexities is the growing demand for more user-centric enterprise IT solutions similar to that of commercial IT platforms as a new generation of technologically-savvy digital natives join the workforce. The modern executive expects polished user interfaces (UI), smooth user experiences, quick response to software issues as well as constant updates, patches and improvements.

ENTERPRISE ARCHITECTURE – AN APPROACH TO TAME ORGANISATIONAL COMPLEXITY

Enterprise Architecture (EA) is a well-known approach to manage organisational complexity and large-scale IT implementations. The Ministry of Defence (MINDEF), Singapore Armed Forces (SAF) and DSTA are currently the leading practitioners of EA in Singapore, having developed CARAT, the Actionable Architecture Framework for MINDEF Corporate IT in 2006. This EA framework establishes four key architectural pillars: (a) Business Architecture (BA) to drive process standardisation; (b) Information Architecture to reign in data integration; (c) Systems Architecture to consolidate the systems landscape; and (d) Technical Architecture to manage the technology and standards for the organisation (see Figure 1).

The Value of Enterprise Architecture

Within EA, a BA framework ensures consistent and succinct representation of business processes by setting standards for framing various business perspectives. In MINDEF and the SAF, these standards were adapted from the Operational View (OV) concept¹ of the US Department of Defense Architecture Framework. With a systematic definition of processes, people and transacted data, the BA framework presents a holistic view of an organisation's business landscape for better decision making.

Processes mapped under BA are then associated and represented with their supporting data resources, systems, technologies and standards via System Views (SV) and Technical Views (TV)². This allows for better business-IT alignment – stakeholders can quickly understand what business processes are impacted as the IT landscape evolves, and IT leaders can direct IT capability delivery and systems development needed to deliver business outcomes and value.

EA has been used successfully in MINDEF and the SAF for large-scale enterprise-wide IT projects such as Enterprise Systems and Enterprise HR systems³. The strong foundation of EA practice within DSTA has also enabled the organisation to push for a Model-driven Architecture approach to enhance agility and speed in the implementation of enterprise IT systems (Lai, Ng, & Low, 2015).

The Downsides to Enterprise Architecture

However, one of the inherent downsides in adopting the EA approach in enterprise IT projects is that user centricity tends to get compromised.

The EA approach advocates for an enterprise mindset necessary to drive enterprise-level integration of business and technology. The goal is focused on enabling capabilities that the organisation needs, determining key functionalities the system must have and how it integrates with other systems and aligns to architecture standards. Such an approach helps to deal with the complexities involved in a myriad of business processes and complicated IT landscape but also has the tendency to de-emphasise the human dimension in system design.

As a result, focus on end user experience is lost amid tight implementation schedules and the absence of an end user advocate within the Project Management Team (PMT). This is why while many Enterprise IT projects start out with usability as a desired end-goal, few succeed in delivering that promise.

Another downside to the EA approach is the mismatch between the effort (and corresponding time) required to articulate and define the enterprise landscape and the burgeoning pace of today's technological advancements. The current EA approach needs to be enhanced to grant organisations greater agility and responsiveness to innovation and market disruptions. Delivery cycles need to be more iterative and move away from traditional big bang approaches.



Figure 1. The four key architectural pillars of EA

In summary, while the EA approach does help to manage organisational complexity, it could do better in the face of increasing demand for user-centric and responsive enterprise IT solutions. Hence, new approaches and strategies have to be adopted.

DESIGN THINKING - BUILDING ENTERPRISE SOFTWARE THAT PEOPLE LOVE TO USE

Design Thinking is the brainchild of Tim Brown, president and CEO of IDEO⁴, who describes Design Thinking as a human-centred approach to innovation that draws from the designer's toolkit to integrate the needs of people, the possibilities of technology, and the requirements for business success.

Design Thinking has gained prominence in recent years, with many companies and public sector organisations starting to acknowledge its value in bridging the gap between the enterprise and its end users. Within Singapore's Public Service Division, the Human Experience Lab was established in April 2012 with the aim of using Design Thinking to help agencies design and develop public policies, services and experiences that are more citizen-centric. Since its inception, it has worked with various government agencies on projects tackling a wide range of public issues such as *Project Love Punggol* with the National Environment Agency that aimed to create a better living experience for Punggol residents (Siti Maziah Masramli, 2013).

Unpacking the Essentials of Design Thinking

Design Thinking can be seen as a problem formulation and problem solving approach that emphasises having a designer's mentality as well as a familiarity with methodologies and tools that designers use.

Adopting a designer's mentality involves balancing the differing constraints posed by: (a) business requirements; (b) existing technological products and standards; and (c) end user needs and desires when designing for a solution to a particular problem. While constraints posed by business requirements and technology are normally defined and gleaned easily, figuring out accurately what the needs and desires of end users often turns out to be a trickier task involving much trial and error, patient listening, close observation and a sense of empathy and connection with the users in mind.

To better aid project managers and system designers in these tasks, various organisations are beginning to develop methodologies and tools based on years of experience and accumulated best practices⁵. Within DSTA, its Design Thinking methodology⁶ can be summarised as an iterative and three-step cycle: understand, explore and test (see Figure 2).

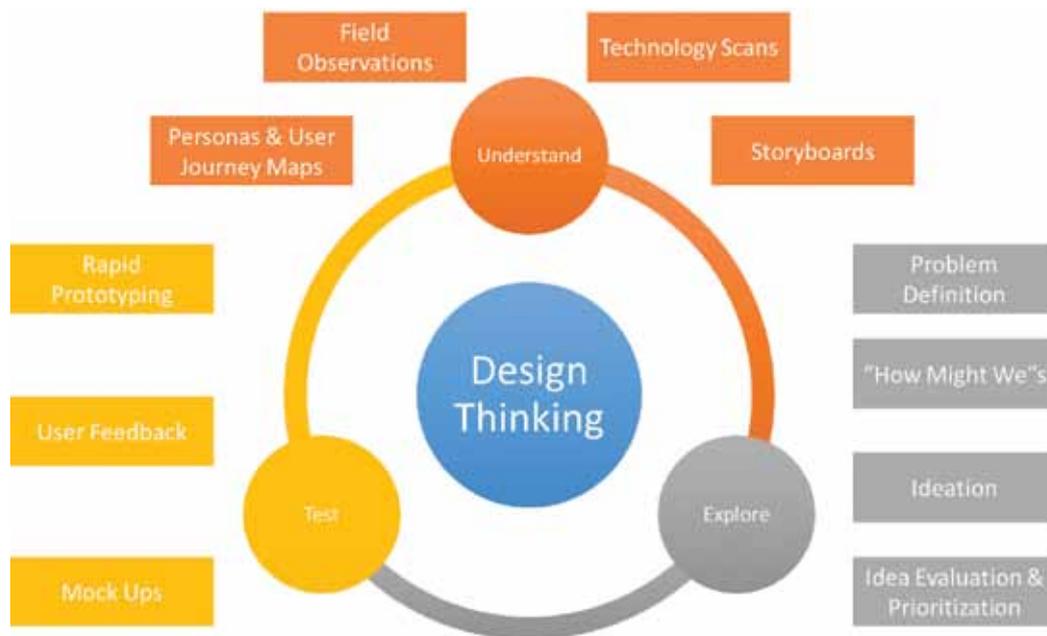


Figure 2. Design Thinking methodology and tools

Understand Phase

During this phase, the key focus is on developing a deeper understanding of the characteristics and motivations of the end user, along with his problems and (often latent or unspoken) needs. Using a variety of techniques such as interviews and field observations, the Design Thinking team attempts to piece together a narrative of the end user journey (e.g. within a business process or user scenario), detailing the issues encountered, frustrations faced, innovative solutions they use or why they love a particular function. This is represented in the form of user journey maps and user personas, and the insights gleaned can help the team to sharpen its focus on core issues and user needs in the form of ‘How Might We’ (HMW) problem definitions.

Explore Phase

HMWs shape the scope for subsequent exploration phases, where the Design Thinking team engages in multiple divergent and convergent styled thinking cycles to generate, evaluate and prioritise ideas repeatedly using the user personas and user journey maps as a preliminary test of its ideas.

Test Phase

Ideas that are assessed to be worth exploring undergo testing where the Design Thinking team iteratively creates prototypes of increasing fidelity and tests each prototype with actual end-users to seek verification on whether the proposed idea is of value to them.

Applying Design Thinking in Enterprise IT Projects

The key strength of Design Thinking, as compared with the EA approach, is its focus on human-centricity through empathy and the emphasis on rapid prototyping – testing ideas early and iteratively with end users. Drawing reference to enterprise IT projects, Design Thinking is an important complementary approach to EA during the requirements gathering and system design phases of the project.

During requirements gathering, it is critically important to chart out accurate business processes that would drive the corresponding design of the enterprise IT solution. The EA approach provides a clear and defined means to capture these processes from a business goals and functions standpoint. Design Thinking can be used at this juncture to verify these captured processes and ensure that the perspective of the end-user is taken into consideration by uncovering insights from the ground level (e.g. manual workarounds, pain points). With these insights, process maps that previously only captured inter/intra organisational linkages via the EA approach would then be improved upon or entirely redrawn to obtain greater business value and better user experience.

Design Thinking also empowers project managers to better translate high level intent, concepts and business processes into concrete and implementable design and solution components during system design. While the EA approach provides a holistic view of the interconnected enterprise business processes, Design Thinking allows organisations to

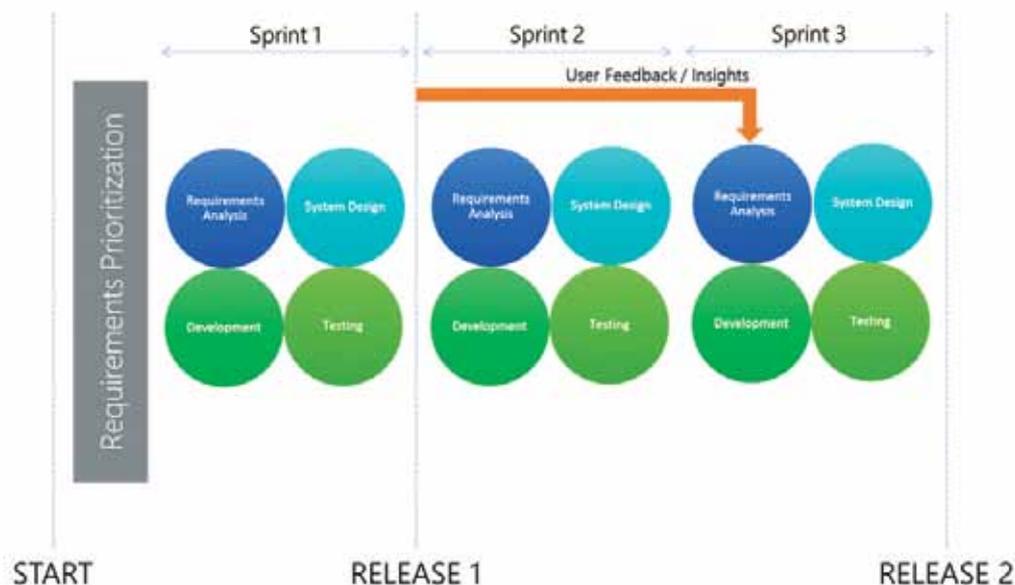


Figure 3. Agile Development Methodology

dive into individual business processes and engage with end users via a series of prototypes and mock ups. This allows the quick verification of second level user requirements to ensure that the ensuing system design is truly tailored to the end users' needs. Hence, the integrated EA and Design Thinking approach allows project managers to design and/or evaluate system designs with both breadth (enterprise view) and depth (end user view).

AGILE DEVELOPMENT – DEPLOYING ENTERPRISE SOFTWARE QUICKLY AND RESPONSIVELY

Agile Development is a software development approach based on the Agile Manifesto⁷. It advocates for the logical breakdown of user requirements into small incremental tasks, whereby requirements analysis, development, testing and deployment activities happen in quick, short successive sprints that build upon one another (see Figure 3).

This is in contrast to the traditional waterfall development approach that many enterprise IT projects still adhere to, which defines each phase of requirement analysis, development, testing and deployment clearly, whereby a project can only proceed to the next phase upon the successful completion of all activities within the current phase.

With Agile Development, user involvement is high as stakeholders are involved at the end of every developmental phase (aptly termed as a 'sprint') to co-create and verify the developed solution. Releases can be scheduled once a minimum viable product can be achieved, which shortens the deployment time for an enterprise IT project significantly.

Applying Agile Development in Enterprise IT Projects

Agile Development can be seen as a natural follow-up approach to Design Thinking during the development, testing and integration phases of an enterprise IT project, with its similar focus on iterative verification of solution and emphasis on end user involvement⁸.

During these phases, enterprise IT project managers often find themselves having to balance conflicting organisational demands, project resource limitations and new ground level inputs. They also have to operate within an evolving and dynamic environment which requires them to have finesse in managing project implementation with agility.

With Agile Development, deployment can occur once a minimum viable product is achieved. This not only shortens the deployment time for the project significantly, but also creates more avenues to glean insights from ground users, as

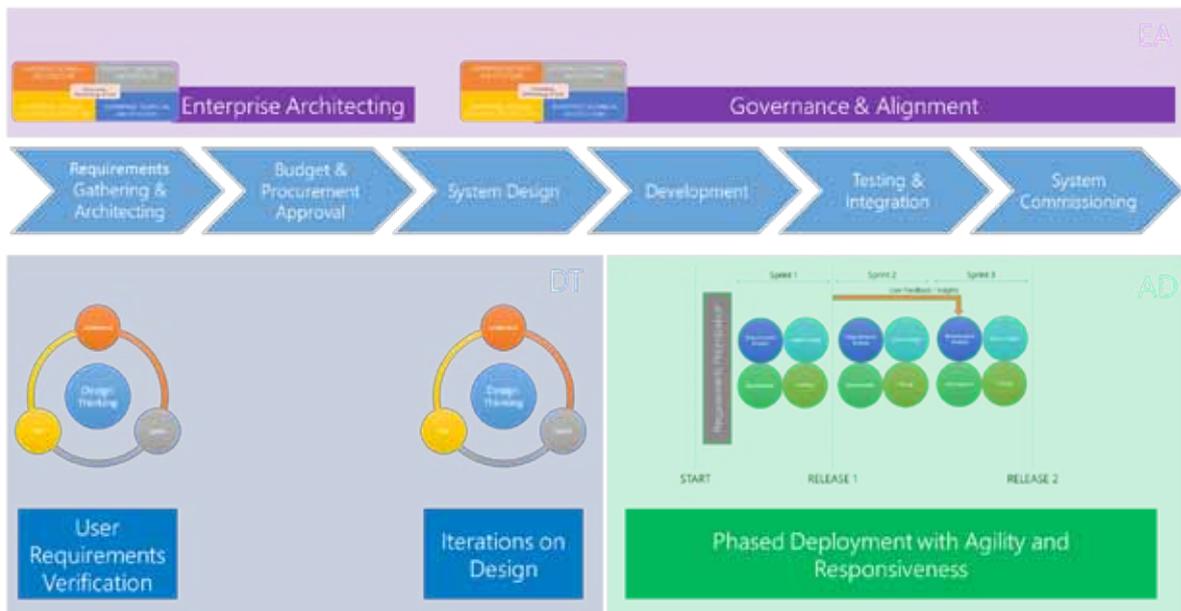


Figure 4. EA+DT+AD applied in Large Scale Enterprise IT Projects

emphasised by the Design Thinking approach. By observing first-hand how end users interact with deployed systems, the project manager can glean valuable insights and lessons that would form the basis for further enhancements to the system design which could in turn be incorporated into upcoming Agile Development sprints. Last minute requirements and technological advancements can be handled likewise, allowing for a much more flexible and nimble way of managing requirements. Additionally, such a deployment strategy is also greatly user-centric and allows organisations to be responsive and attentive to the issues of end users.

In addition, as deployment risk is evaluated and managed at the end of every sprint, project sponsors will have increased confidence in achieving project success, and hence will be more open to product and process innovation via trial and error.

In summary, by integrating Design Thinking and Agile Development with the existing EA approach across the enterprise IT project life cycle, project managers can better manage project complexities without compromising on user-centricity and project responsiveness (see Figure 4).

LEARNET CASE STUDY

Using the case study of the development of MINDEF and the SAF’s enterprise learning management portal, LEARNet Portal 2.0, this article shares how EA, Design Thinking and Agile Development methodologies were integrated together and adopted by the PMT to overcome various project challenges.

LEARNet is a complex and large-scale programme involving multiple stakeholders across training command, institutes and units that leverages the latest learning and mobile technologies to transform learning in the SAF (Ministry of Defence Singapore, 2012). LEARNet Portal 2.0 is the online platform where instructors, trainees and commanders access the learning management system and collaboration platforms to carry out training and learning. Key business processes include course management, methods of instruction, knowledge sharing and collaboration with multiple business stakeholders and end users. To deal with these project challenges, the team from DSTA established EA, Design Thinking and Agile Development as key pillars of its development approach (see Figure 5).

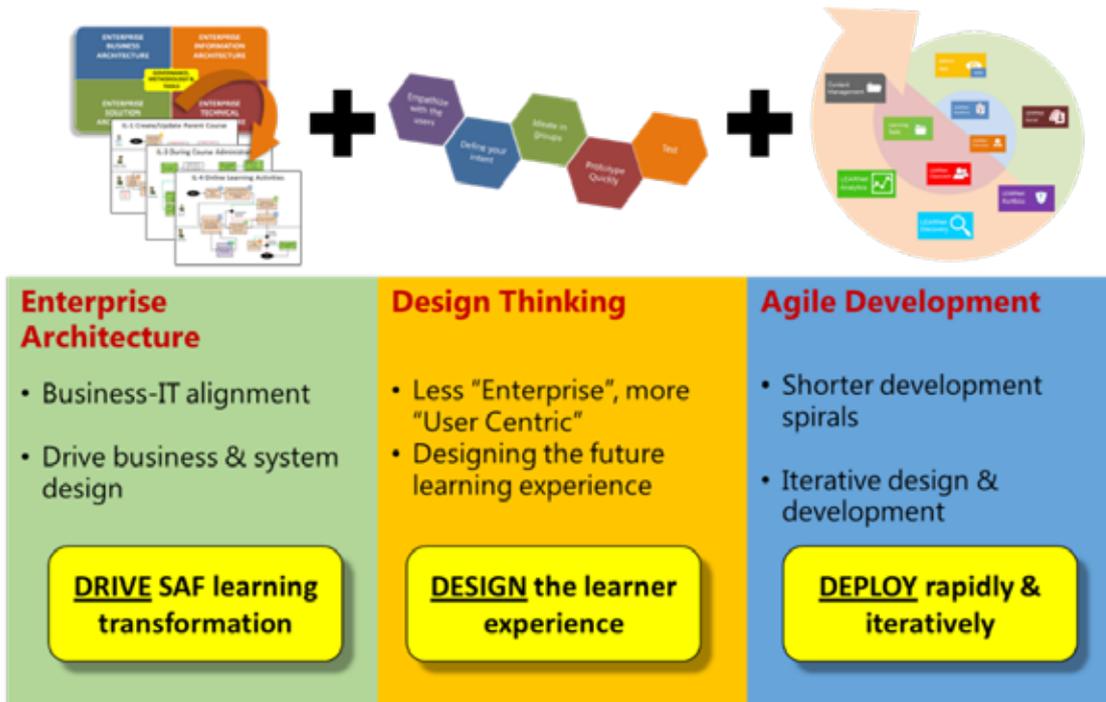


Figure 5. LEARNet programme development approach

Requirements Gathering Phase

During the initial stages of requirements gathering, there was a lack of clarity on the desired future end-state for the SAF's learning transformation as various stakeholders had different understanding and pedagogical perspectives on how technology could be applied.

The EA framework provided a common language and systematic approach for the PMT to articulate, capture and translate desired future business landscapes into technical design (see Figure 6). The design of the new online learning

experience for the LEARNet Portal 2.0 began in earnest with a series of EA workshops.

Through the workshops, different business stakeholders were able to come quickly together to harmonise and agree on the new business scenarios and processes (see Figure 7). These scenarios and process maps were used as a foundation to develop the solution and technical architecture. To ensure requirements traceability and tighten business-IT alignment, detailed functional requirements were generated from the original process maps and mapped to solution components within the solution architecture.

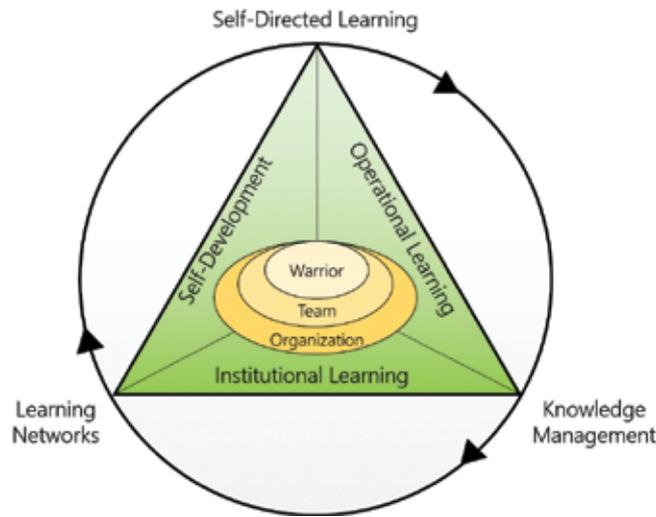


Figure 6. BA for LEARNet programme (Adapted from Goh, Tan, & Lim, 2008)

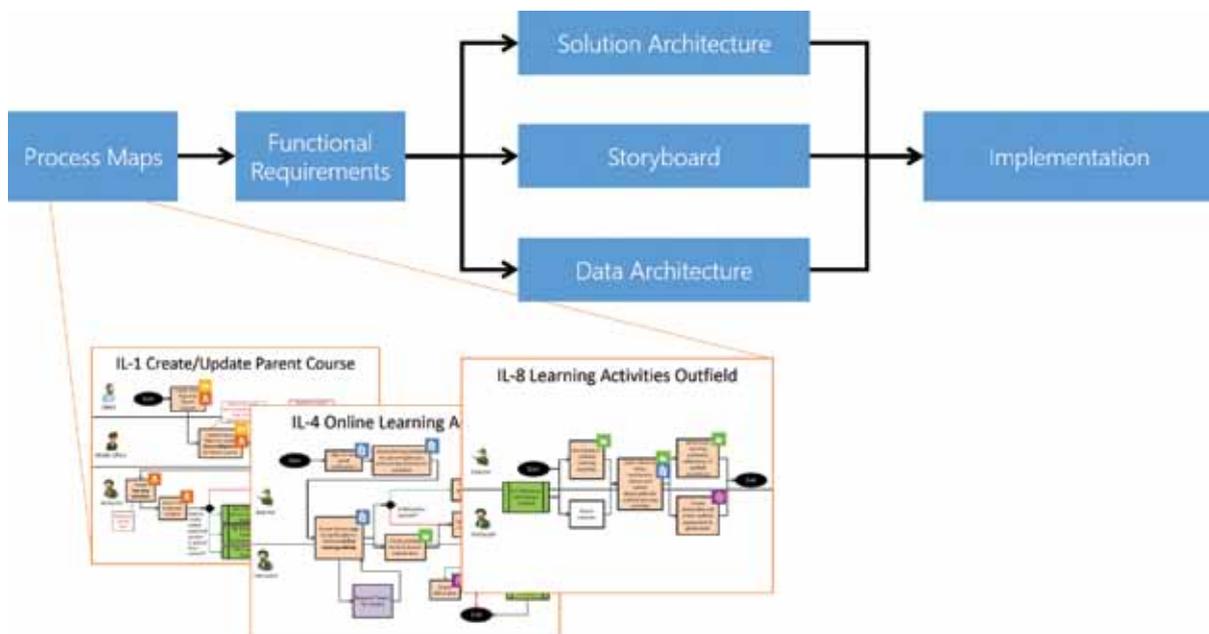


Figure 7. Process maps generated from EA workshops

System Design Phase

During the design and development phase, Design Thinking was used extensively to guide the solution design as well as to gather end user feedback. Key business scenarios and processes developed earlier using EA became key inputs for the Design Thinking approach. These were translated into story boards for prototype development and simplified walkthrough demonstrations with users. To get inputs and finalise the design for the learner mobile application, the DSTA PMT moved away from the traditional approach of presenting design concepts only to the Operations Manager for endorsement, and also sought feedback from end users via a series of design workshops involving instructors from training institutes.

These workshops were conducted in an innovative manner – existing commercial design and UI principles were first shared with instructors, and they were also encouraged to think of products and experiences that they considered to be well-designed. After the initial framing process, instructors were shown several LEARNet Portal 2.0 design concepts via low fidelity prototypes and then grouped with supporting UI designers from the industry to improve on the proposed design. After this process, the instructors then came back together to vote for their favourite design elements which were then incorporated into the final solution for the learner mobile application (see Figure 8).

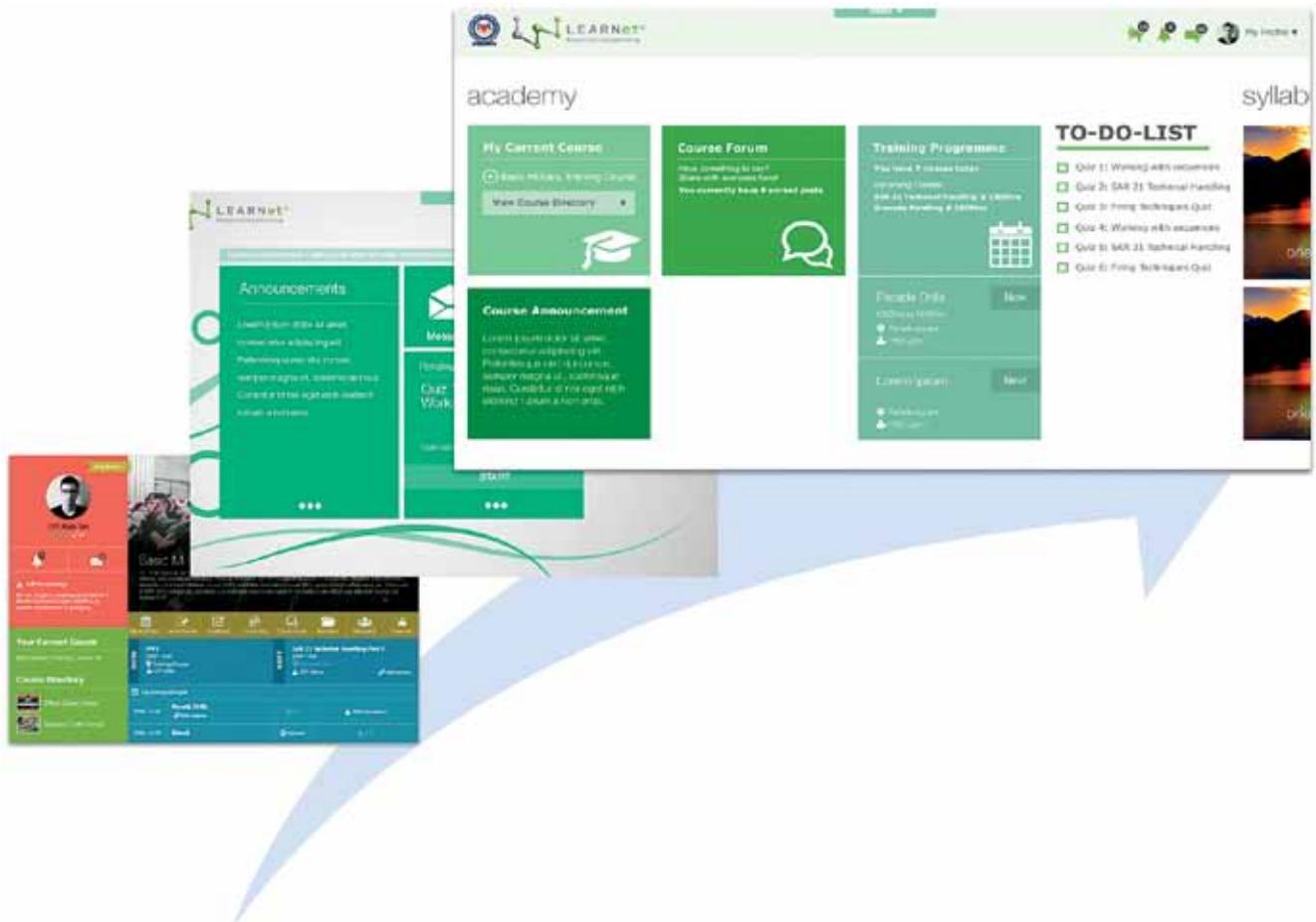


Figure 8. Iterative designs for the learner mobile application

This method of crowdsourcing and co-creation with end users yielded downstream benefits during the implementation phase. Most notably, there was a significant reduction in the need for end user training for the learner mobile application due to its intuitive and more user-centric design. Getting instructors in early into the design process also helped in subsequent change management efforts. Although the learner mobile application was the anchor application for LEARNet Portal 2.0 with the greatest number of end users (over 10,000 trainees from different training institutes during the roll-out), there were much fewer requests for enhancements compared to the other similar systems.

Besides UI enhancements, the PMT also leveraged insights garnered from discussions with instructors and trainees to suggest improvements to existing business processes that led to the development of new functionalities such as a 'pack-and-go' concept. This allows learners to pre-download the most updated course content in camp and then access the content outfield without any connection, hence allowing for more efficient and focused training.

Development Phase to Deployment Phase

Additionally, the PMT also sought to incorporate elements of Agile Development to shorten delivery lead time, proposing a phased deployment strategy by splitting up delivery of the basic learning management system from other components like collaboration, community and enterprise content management modules. Such a strategy allowed the team to focus on delivering the minimum viable product, and what would have taken upwards of 18 months to build was completed and deployed within 10 months, along with the latest user-centric features and UI designs. Post-deployment, the team has continued to develop additional enhancements based on user feedback and insights gathered from pilot training institutes and subsequently deploy these enhancements as part of different releases.

CONCLUSION

EA, Design Thinking and Agile Development were implemented within the LEARNet programme as synergistic approaches spanning across the user requirements gathering as well as design and development phases, with clear benefits reaped during the implementation phase. EA helped to provide a strong foundation to manage complexity in which business requirements were gathered, rationalised and harmonised. Design Thinking maintained the focus on user-centricity during the design phase to yield solutions that enhanced the learning

experience, requiring less change management efforts and user training. Agile Development maintained this focus on user-centricity throughout the development phase until deployment and also reduced system delivery time.

Through these efforts, Design Thinking and Agile Development were thus assessed to be useful and complementary approaches to EA that can collectively yield greater benefits for corporate IT departments willing to embracing them, particularly for large-scale complex projects.

WAY AHEAD

The importance of Design Thinking in the IT industry and organisations is increasing, a view shared by many industry thought leaders (Kolko, 2015). Organisations are recognising the strategic potential of user-centric design in developing new customer insights for product and service innovation, defining new digital experiences enabled by the latest technology and even enhancing employee engagement. Enterprise IT solutions of today and the future must be designed for people and designed for delight.

DSTA is looking ahead and preparing for this future. It is embracing Agile Development and Design Thinking as extensions to current EA methods. DSTA is seeking to incorporate the Design Thinking approach into existing software development life cycle processes to deliver better and more user-centric enterprise IT solutions in a manner that is more agile and responsive to changes. Through its efforts in LEARNet and other IT projects, DSTA has developed a Design Thinking Toolkit for IT projects and an Agile Development Guide, and is building up its competencies in a bid to equip its engineers with new skill sets and, more importantly, mindsets for the journey ahead.

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ENDNOTES

¹ OVs describe the tasks and activities, operational elements and information exchanges required to conduct military operations. Collectively, these views articulate the complete concept of these operations and are considered to be the BA component of EA.

² SVs describe systems, services and interconnections that support organisations and their operations (as articulated by OVs) whereas TVs define technical standards, implementation conventions, business rules and criteria that govern the architecture.

³ Lim, Teng, Low, and Tan (2014) discusses EA implementation across the various projects and shares the real-world benefits experienced from this initiative.

⁴ IDEO is a global design firm that takes a human-centred, design-based approach to help organisations in the public and private sectors innovate and grow.

⁵ IDEO produced a Design Thinking for Educators Toolkit that goes through the design process (Discovery, Interpretation, Ideation, Experimentation and Evolution) and suggests activities to better interact with users and understand their requirements. Likewise, software companies like Thoughtworks have also developed and shared tools (such as stakeholder map practice and user relationship matrices) to better aid Design Thinking practitioners.

⁶ Adapted from Design Thinking and Innovation Academy (DTIA), WSQ The Tools and Methods for Implementing Design Thinking, Design Singapore Council, 2013.

⁷ Agile Manifesto is a set of principles largely summarised as “Individuals and interactions over process and tools – Working software over comprehensive documentation – Customer collaboration over contract negotiation – Responding to change over following a plan.”

⁸ Popular agile software development methods based on this approach include SCRUM, lean software development and Kanban. This article utilises the SCRUM practice for discussion on the merits of Agile Development in enterprise IT projects.

BIOGRAPHY



TAN Tow Hua Joseph is Programme Director (Enterprise IT) of LEARNet. He also held key appointments in the Ministry of Defence's (MINDEF) Chief Information Officer Office and was involved in managing MINDEF's IT investment portfolio, spearheading the SAP Enterprise Resource Planning implementation and IT governance initiatives such as portfolio management and Enterprise Architecture. Joseph graduated with a Bachelor of Arts (with Honours) and Master of Engineering degree in Electrical Engineering and Information Science from the University of Cambridge, UK, in 1998.



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