Corporate Research and Intelligence
Australian and global software development trends

An analysis of emerging trends we have identified which may be impacting on Software developers within Australia currently. The ATO is learning from the context and experience of partners in the Software industry to better understand any change impacts on the industry.

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Introduction

The Software Industry Partnership Office (SIPO) has requested information to analyse emerging trends on Software developers and how they may impact on the ATO. This is expected to provide insights that will help to shape future decision-making with software developers and provide some transparency about what has shaped the ATO's view. The Scan explores common themes occurring in the Software industry and draws upon information discovered internally combined with open source online information. Overall the Software industry is undergoing a systemic evolution towards a more transparent, flexible and standardised industry.

Key Findings

- Software developers have told us that we need to work with them to understand their environment, informing them early about legislative change and reviewing and answering software developer questions, so they can get it right. Sharing this industry information with software developers will demonstrate our growing understanding of their environment

- DevOps is common practise for Software developers and is a concept describing frequent collaborative interactions between developers and operational staff. Closely related concept to agile development methodologies with similar focuses of continuous communication, collaboration and cooperation of all relevant stakeholders in any given software project to enable a timely and reliable solution.

- Open source software promotes publicly available open standards for software development, so software can easily be standardised, enhanced and used by other products. Governments around the world[1] have been promoting the use of open source software in their respective public services and cloud computing is on a similar trajectory with many governments adopting 'cloud-first' policies.

- Offshore software development is increasing due to cost efficiencies but continue to face language or cultural barriers, time-zone and testing difficulties. Companies should be especially vigilant at the outsourced company's national law on intellectual property rights and the protection of sensitive data.

- Enterprise apps are a rapidly growing industry with the expectation of a steady future growth with today's digital workplace using an average of three devices in their daily routine and are expected to grow further, in line with the Internet of Things (IoT)[2]. Enterprise apps lag behind in the app development world when compared to other market segments like gaming apps or developer tools, and is handicapped by progression in security assurances.

- Tools used by software engineers have been incrementally improving mainly by simplifying the software creation process. 'Rapid mobile app development' tools make it possible for the community, without prior software knowledge, to develop apps, opening up the marketplace to new innovative ideas.

- App security is a major challenge for Software developers, especially with the increased demand in enterprise applications. Currently there is no perfect security testing measure. A variety of security measures are used to currently get a more comprehensive security assurance. The ATO must ensure that improvements in security measures are incorporated in new apps.

- API's are attached to software products and act as a translator between a user's request inputs and the software's understandable language. API solutions are expected to quadruple in growth by 2020. Enterprise integration and digital security will be the next big drivers of APIs. ATO use of APIs can assist to decrease costs of compliance by allowing taxpayers to use natural systems to connect with the ATO.

- Bots beginning to emerge in Social Media potentially as the next wave in software development[3]. The ATO needs to begin to discuss with developers any potential uses of bots for ATO needs.

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[1] Center for Strategic and International Studies (CSIS). Register for Government Open Source Policies
[2] Gartner Says Demand for Enterprise Mobile Apps will Outstrip Available Development Capacity Five to One Gartner
[3] Bots Explained by CNBC website

Key Considerations

The ATO is positioning itself well in transitioning towards a more digitalised work environment and has adopted good practises from the digital transformation office, including;

- Adopting agile methodology[4] principles

- Implementing the 'cloud-first' policy[5]

- Using a standard framework[6] for transferring of data

Looking forward the ATO should consider hiring multi-disciplined staff in the future for DevOps[7] purposes whilst promoting and empowering an internal culture of innovative software solutions.

Offshoring software development can be a cost effective solution, however it must also be handled delicately. If offshore solutions are suggested, the ATO might consider setting comprehensive 'ground rules' to counter any language barrier issues, time-zone issues or any intellectual property rights issues and potential legal issues if security is breached.

Block chain is an emerging financial software distribution ledger that has real-time transaction recording capabilities and has the potential to prevent many forms of cyber-crime. The ATO has begun researching[8] the topic and is expected to be providing more comprehensive insight soon on the Intelligence Products Repository.

The ATO should continue to watch enterprise applications to see what innovative solutions are developed as this market segment is expected to undergo rapid growth given that today's digital workplace is already using an average of three devices in their daily routine. The ATO will need to procure solutions with sufficient security assurances and will be the main setback for enterprise application adoption.

The ATO might consider investing in some advanced, user friendly developer tools to be available to all employees and promote their use among all staff. However the ATO would likely benefit from ensuring the implementation is tactical, to avoid the rise of a Shadow ICT culture.

The ATO is understandably vigilant on the security of apps that use our clients' data. To avoid security compromises the ATO could continue to consider building and maintaining its own internal cloud, thus moving to a hybrid cloud environment[9].

The ATO is likely to continue to see a benefit from sending representatives to annual software related conferences like GovHack[10], APIdays[11] and other technology/digital conferences like CeBIT.

Provision of APIs by the ATO can assist in reducing the cost of voluntary compliance by allowing taxpayers use their natural systems for meeting tax and super obligations.

ATO employees could monitor the IBISWorld website statistics data to assist with benchmarking or identifying key stakeholders that influence certain market segments. The ATO could leverage this data when it comes to auditing taxpayers to gauge insight into the industry, thus providing tailored and well researched response to tax claims.

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[4] ATO internal reference
[5] ATO internal reference
[6] SBR Government website
[7] Definition of DevOps Tech target website, contribution by Chris Riley
[8] ATO internal reference
[9] ATO internal reference
[10] GovHack website dedicated to GovHack events
[11] APIdays; Platforms for innovation

Introduction

The Software Industry Partnership Office has requested this scan to analyse emerging trends impacting on Software developers and how they may impact on the ATO. The ATO is learning from the context and experience of partners in the Software industry, with this scan being one aspect of the ATO's commitment to fortify this partnership. This scan explores software development, distribution of software, offshoring software development, mobile applications and trends in the use of APIs.

Trends in development methods

Mobile compatibility

Mobile compatibility has become a key innovation driver for developers. Software developers must now enable their software to be accessible on a variety of platforms.

In May 2015 Google recorded more searches taking place on a mobile device than on desktop computers in 10 countries[12]. Consumers are increasingly demanding their software, such as Google, be mobile friendly. Accordingly, Google has modified its search algorithms to increase the weight on search results towards those that are more 'mobile friendly'.

Consumers are demanding their experience move with them to any device they use. This increases the pressure for all software services to be compatible across platforms. To stay relevant in the forever updating digital world, the Software industry is responding to consumers and mitigating losses of market share to their competitors who have adopted the more modern approach to their digital services.

These drivers are leading developers down the path of responsive or adaptive design solutions for websites. Both design methods change the appearance of the site based on the browser environment they are being viewed on. Responsive design is said to be more flexible as it can adjust to any size browser. Adaptive design has pre-set browsers sizes it can conform to, but not custom sizes[13].

The ATO website is already accessible across different device platforms, including both iOS and Android, with MyGov following suit. In order to guarantee mobile and tablet access for all ATO staff utilising Bring Your Own Device (BYOD)[14] and virtual desktop platform (VDP)[15] policies, cross-platform integration of most, if not all, future software initiatives would be advisable. This may then have the added benefit of an improved client experience and a more user friendly interaction resulting in increased customer confidence.

Single-page apps

Single page apps are loaded as a single HTML page in the browser and upon interaction with the app's relevant parts of the page are dynamically updated. Facebook is a good example that most people can relate to, that uses single page app design[16]. Web design has moved towards these more flexible web-page apps and is championed by the lack of page reloads. Single page apps eliminate the need for page reloads when navigating through the app or performing app's tasks.

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[12] 5 hot trends in software development hiring CIO website by Sarah K. White
[13] Responsive vs. Adaptive Design: What's the Best Choice for Designers? Studio Website by Jerry Cao.
[14] ATO internal reference
[15] ATO internal reference
[16] Uncovered: Single page applications: Price Waterhouse Coopers, by Adnan Jaswal

HTML pages with JavaScript's interaction logic makes for a more fluid browsing experience where the browser shares the workload and removes the need for bulky websites working on the traditional request/response cycle.

The ATO already utilises responsive/adaptive designs in its website and should continue to consider incorporating this, if appropriate, into any future public facing websites. The ATO has already started transitioning to a cross platform internal software infrastructure to support the BYOD policy, and responsive/adaptive design could be considered for tablet or mobile access to enterprise software, again where appropriate.

DevOps and Agile development

DevOps is the practice of operations and development engineers participating together in the entire service lifecycle, from design through the development process to productions support. This practice has been increasingly used internationally.

DevOps has been developed as a reaction against the silos and inflexibility that existed in the relationship between consumer and product/service provider. Agile product development has been growing in the Software industry in recent years. Agile has been a key driver behind the shift towards DevOps. It helps teams to respond to unpredictability through incremental, iterative work cadences, known as sprints. According to the Manifesto for Agile Software Development, its core values focus on:

- Individuals and interactions over processes and tools

- Working software over comprehensive documentation

- Customer collaboration over contract negotiation

- Responding to change over following a plan[17].

Another interconnected emerging trend is an understanding of the value added when collaboration between development and operations staff throughout all stages of the development lifecycle occurs. Collaboration between development and operations staff is more of an extension of the agile work principles to include external stakeholders who will be receiving the product into the development process.

DevOps fosters an environment of continuous improvement and sustainable pace for all stakeholders[18]. Commonly this includes implementing Infrastructure as Code which provides the ability to design, implement and deploy app's infrastructure with known software best practices. This appeals to developers as it supports the adoption of cloud computing and Everything as a Service (XaaS) and allows developers to rapidly deploy.

Adobe is a good example of this new way of doing things. After deploying CloudMunch[19] DevOps platform Adobe has increased the pace of application development by as much as 60 percent[20]. Major benefits include cost reduction, faster execution and improved error detection and troubleshooting. Product development teams have been able to pare delivery time by 50% or more via this development method.

The ATO has adopted the agile methodology and has implemented Scaled Agile Framework (SAFe) as an organised way of introducing agile work principles into the office. The ATO is beginning to take advantage of Software developers and their DevOps environment by now engaging with Software developers through teams like the Software Industry Partnership Office (SIPO).

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[17] Manifesto for Agile Software Development Agile manifest website, Multitude of authors
[18] DevOps, Kloia website
[19] CloudMunch website
[20] The Next Wave of Software Delivery – Integrating Agile and DevOps for the Digital Enterprise DevOps website

Open Source software

Governments including Indonesia, the UK, Denmark and the Netherlands have been promoting wider use of open source in their respective public services[21]. Open source[22] is based on publicly available, open standards which means that apps can be more easily standardised across departments or agencies. Open source allows any vendors to develop different software solutions that are compatible with one-another, and for this reason open source can be a key driver of government transformation. Adopting open source and open standards means governments can have the flexibility to tailor these apps with a high degree of customization to their exact needs. This is especially true with new and emerging technologies like big data supporting web and mobile services for the digital citizen.

Indonesia's tax agency has shifted from the use of proprietary systems towards more flexible, free open source systems. The Indonesian tax agency reported "We spent only 10 per cent with open source compared to using proprietary systems."[23] A substantial 90% was saved on Information and Communications Technology (ICT) costs by transitioning to open source systems. Much of the savings have come from cheaper maintenance costs and free licences due to open source software. However, critical systems still remain on proprietary software because of support concerns and the Indonesian agency works on a very different model to the ATO with many more decentralised offices.

Governments in the UK, Denmark the Netherlands have also been promoting wider use of open source in their respective public services.

- Mark Dearnley, the Chief Digital & Information Officer of the UK's Her Majesty's Revenue & Customs (HMRC) told the **'Open Source & Open Standards'** conference that open source will change the way they operate in the future and that open source solutions were likely to be massively cost effective.[24] HMRC has 42 open source solutions already in use however 95 per cent of their software is still proprietary. Examples of open source apps in use include the web browsers Apache and Nginx, database systems Mongo DB, MySQL and Postgres, and programming languages Clojure, Groovy, Ruby and Java. HMRC also uses Suse Linux, the LibreOffice office suite and Apache Maven, for software development project management. The HMRC is also interested in OpenStack as an open source cloud computing solution.

- The Dutch parliament wants to make it mandatory to use open source solutions when equal to or better than proprietary solutions for all ICT projects over 5 million euros.

- Factors such as no licensing fees, open source codes, reusability and connectivity with other systems are some of the leading reasons why the Danish government sees great potential in open source software as mentioned in The Danish Software Strategy.[25]

The Australian Governments Open Source Software Policy requires all agencies to actively consider open source software for all software procurements.[26]

There are a number of potential implications for the ATO to consider when making decisions around procurement of software in the future. There are likely to be cost reductions and flexibility by using open source software. Increased use of open source software could foster an experimental and innovative culture, potentially leading to more robust and customised ICT solutions. It is also likely that the ATO would need to attract highly skilled IT staff.

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[21] Government Open Source Policies Center for strategic and international studies by James Andrew Lewis
[22] ATO internal reference
[23] Indonesia Tax Agency Saves 90% with Open Source on Soylent news website, posted by Azreal. FutureGov extract.
[24] CIO UK tax authority: "Open source is massively cost-effective" on Joinup website by Gijs Hillenius
[25] Open source software and the Public Sector Ministry of Science Technology and Innovation Denmark
[26] A Guide to Open Source Software for Australian Government Agencies by the Australian Government Information Management Office. (downloadable file)

Potential issues with open source software include legal issues around intellectual property rights and support issues when problems arise with the software.

Cloud by default

Cloud computing is the practice of utilising a network of remote servers hosted on the Internet to store, manage and process data. Cloud computing has become so integrated into industry software platform solutions that it is expected to be soon 'simply become synonymous with computing'[27].

The growing diversity of services available via cloud computing is known as Everything-as-a-Service (Xaas) and it includes Infrastructure as a Service (IaaS), Software as a Service (SaaS) and Platform as a Service (PaaS). For small and medium businesses that choose to adopt these innovations, cloud computing is responsible for up to 40 percent more cost effective ICT services, compared to them running their own ICT infrastructure[28].

Most government agencies are transitioning to adopting the "cloud-first" policy with the U.S in Feb 2011[29], the U.K in 2012[30] and Australia in Oct 2014[31]. Cloud adoption in government agencies has been slower than expected predominately due to security concerns with cloud storage of information.

Given the velocity in which cloud computing is being developed and utilised, it is reasonable to expect some aspects may have fallen behind, with security being an obvious example. Security is the number one concern with cloud first policies, especially when the hosting company holds all the data[32]. This security fear is a driver towards adopting a hybrid cloud whereby a smaller private cloud is used for quicker, more sensitive reasons, and the public for the larger and more complex tasks[33]. Online privacy is a big concern for consumers and in some cases vendors are providing security assurance from data breaches, like Cloud Security Alliance STAR matrix[34], to bring peace of mind to their consumers.

The ATO has already enacted a "Cloud-first" policy following the Australian Public Service trend in October 2014[35]. The ATO is finalising a high level view of how the ATO should develop and integrate ICT security into its adoption, procurement, implementation and management of cloud services. The ATO might consider going to the hybrid world where more confidential information can be stored on our internal cloud infrastructure, minimalizing the security risks.

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[27] Software development trends to look for in 2016 on InfoWorld Website by Carlos Melendez
[28] 8 facts and interesting tidbits about the cloud On Silver-lining website
[29] Federal cloud computing strategy Whitehouse website by Vivek Kundra (U.S. CIO)
[30] Government adopts 'Cloud First' policy for public sector IT on Gov UK website by Cabinet Office
[31] Australian Government Cloud Computing Policy Australian government Finance website
[32] The 5 cloud risks you have to stop ignoring InfoWorld by Roger A. Grimes
[33] Risk-Aware Data Processing in Hybrid Clouds on UTdallas website multiple authors
[34] CSA STAR: The Future of Cloud Trust and Assurance Cloud security alliance
[35] Australian Government Cloud Computing Policy Australian government Finance website

Distribution of Software

Renting and subscription based models

The Software industry is currently undergoing a huge shift, and renting instead of buying is a growing commonality in terms of software and software services in the private sector. Choosing to rent infrastructure or software supports todays more agile work environment, and instead of committing to lengthy locked in contracts consumers can have the flexibility to shop around. This has adversely made consumers less patient in waiting for software delivery or error fixing and has reportedly had a flow on effect to developers where quality is sacrificed for timeliness[36]. For developers this is an acceptable sacrifice in the new environment as they can continue to provide updates to improve quality at a later date.

Renting is the trending procurement method for computer infrastructure, data centres, software development staff and the software itself. This shift has allowed consumers to focus their funds towards other aspects of their business and brought about the subscription based model for procurement.[37] Subscription based models usually include updates to software and foster an environment where a strong relationship is key to the upkeep and uptime of a software product.

This development is also affecting the software developing company's revenue stream and their business practices Developers are now less reliant on big contracts with huge up-front costs and instead are embracing the more reliable income stream generated from subscriptions. Selling subscription-based software will require a major overhaul of sales teams, channel strategies and delivery partners. Although this shift has put more accountability on the developers to ensure there is a good relationship with the consumer, it has resulted in positive outcomes for both stakeholders.

For consumers this has opened up the market for smaller businesses to also utilise the previously more expensive software solutions. It has provided a more scalable and malleable software solution and removes the hassle of being locked into a solution for a longer period. Consumers can also expect more on-going updates and close collaboration with the vendor and the flexibility and scalability to adopt as much or as little of the software as needed.[38]

Updates to the software all happen at once and that guarantees no users who access the software will be lagging behind; all users will be accessing the same updated software.

The ATO could benefit from procuring software on a subscription model by taking advantage of the potential for customisation, flexibility and scalability to suit ATO needs. ATO may consider managing timeliness expectations and attempt not to rush the developers at risk of reducing quality.

Mobile-Website apps

Software developers have demonstrated an increase in demand for cross-platform access, which is why developers are shifting to creating content in HTML5 format[39]. This enables the developers to provide users the capability of accessing it on all platforms (web browser, iOS, Android etc).

This has reduced the workload required for developers to provide a solution for users on different platforms and eliminates the requirement to re-write content in a different software language.

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[36] State of API report 2016 Smartbear website
[37] Moving to a Software Subscription Model Gartner website by Christy Pettey
[38] Scalable Pricing: A Key Tool for SaaS Success Entrepreneurs website by David Skok
[39] 21 hot Programming trends -- and 21 going cold by InfoWorld by Peter Wayner

The HTML layer is progressively getting faster and running on faster chips, this means solutions offered by developers will be able to compete with native mobile apps in terms of complexity and interactivity, however there are developers who believe native apps are the only way to obtain apps rich in complexity.[40]

The ATO already has a current mobile application available cross platform. If the ATO invests in further mobile applications it is recommended to consider a mobile friend website solution, as it may suit the purpose at a reduced cost to a native app development.

Everything as a Service

Everything as a service (XaaS) is a subset of cloud computing where Software developers provide services all delivered remotely. The term 'as a service' has been associated and used with many core components of cloud computing including software, infrastructure and platforms. The most common and successful example being Software as a Service (SaaS) which is expected to grow at a compound annual rate of more than 20% throughout this decade[41].

Drivers guiding businesses towards XaaS include low entry requirements, minimal capital expenditure, scalability, multi-tenancy and device independence.

Businesses are finding the biggest obstacle to overcome is adjusting internal culture and procedures to align with the agile XaaS model. This delivery method is also changing the way developers operate. Developers providing XaaS must transition to receiving a slower flowing income stream and be ready to get involved with their consumers to ensure they are dynamically tailoring the services to fit their needs. This has resulted in the distribution of the software morphing into a relationship between Software developer and consumer where a number of services are made available for consumption with options to customise to the consumer's preferences.

The ATO could consider these cloud services, especially to save money by scaling the services to optimal levels. The ATO may need to consider obtaining security assurances in these procurements, especially if client data is to be stored externally.

Offshoring Software development

Cost savings

There are different aspects of software development that can be outsourced to an offshore company including testing, web design and programming. Offshoring's main driver is a reduced cost and a shift in focus for internal staff (i.e. the onshore entity no longer needs to maintain the staff tasked with the outsourced service) and is more prominent in larger companies that already have foreign dealings.

The cost savings associated with a business offshoring its software development is attributed to the software engineers outside of the developed countries being compensated less than their counterparts in developed countries, as well as the reduction in their own software staffing requirements thus reducing operating costs. If the offshore company has begun adopting the new wave of changes in the Software industry then miscommunications are at a lower risk as the agile methodology compensates with frequent meetings and a focus on integrated teamwork.

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[40] Web Vs. native: Let's concede defeat Quirsmode website
[41] 2015 Technology Industry Trends On Strategy & website by Tomas J. Casey and Henning Hagen

Obstacles

Offshoring can have some adverse effects including negatively affecting company morale. If employees feel their jobs are threatened then transparency of management and integration of existing staff with offshore developer is a key factor in reducing this risk[42]. Other obstacles should be weighed up before engaging the offshore developer including[43]:

- Language barriers can cause hiccups in the software development process if business requirements or other crucial bits of information are misunderstood. The trend towards the teamwork oriented agile work management has assisted in reducing this risk.

- Time-zone differences pose the biggest threat to agile work management and require more flexibility in all stakeholders to make time for each other as their work days may not overlap.

- Cultural clashes can also cause a rift in the relationship, a good example being the existence of a strong labour union presence in the software service sector which may result in lower productivity in the offshore vendor.

- Testing can be more difficult and time consuming as the offshore company does not have direct access to the consumers ICT infrastructure to test their solution in the live environment.

Security concerns

The biggest deterrent to choosing offshore software development is the potential security concerns that may arise, with these issues not always completely explored prior to contracting the offshore development. Protecting intellectual property and sensitive data is a big concern for companies especially because each countries national law may vary where intellectual property and the protection of sensitive data is concerned[44].

The onshore company must also bear in mind that the security measures may be less than sufficient in the offshore entity meaning if they are in possession of sensitive material they are an access point for that material to become compromised. Network complexities can become more onerous when trying to manage network configurations when an offshore development centre is added. Offshore providers need to ensure they isolate the networks connected between each of their client's systems, as this can be a security vulnerability[45].

The ATO may benefit from offshoring, however due diligence must be done prior to contracting out software development services. It is recommended the ATO intensely research the IP laws, cultural difference and the local labour environment in the offshore country. Agile work methodologies could be adopted to make this option more viable.

Mobile Apps developments

Enterprise apps

Mobile apps are a rapidly growing industry, indicated by the fact that they now have higher annual profits than the entire US Box Office and is expected to overtake the Global box office revenue soon. The demand for enterprise apps is growing with Gartner predicting that by 2017 demand for enterprise apps will outstrip supply by a factor of five[46].

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[42] Operation Offshore On Excelacom website by Patrick Philip
[43] Why offshoring Agile development often doesn't work on CIO website by Lorraine Pauls Longhurst
[44] The 'Outsourcing Offshore' Conundrum on WIPO Website by Donna Ghelfi.outsourcing offshore
[45] The Security Challenges of Offshore Development SANS institute
[46] Gartner Says Demand for Enterprise Mobile Apps will Outstrip Available Development Capacity Five to One Gartner by Susan Moore

The demand is reinforced by economic drivers which reportedly found that 43% of enterprise app developers earn $10,000 per month, compared to just 19% of consumer app developers[47].

"Employees in today's digital workplace use an average of three different devices in their daily routine, which will increase to five or six devices as technologies such as wearable devices and the Internet of Things eventually becomes mainstream"[48]. This increase in demand for enterprise software to be available on mobile and tablet platforms coincides with the emerging Bring Your Own Device policy movement being adopted by industries.

As mobile usage grows and enterprise apps become the norm, the greater the expectation for mobile access to enterprise software. This means each enterprise web app that is considered will have to be capable of being accessed by any device as well as adapting the user interface for ease of use. This major shift has increased the dominance of hybrid mobile apps over native apps and the July 2016 proposed ATO staff app is a web app[49].

Hybrid mobile apps are written in HTML, CSS and JavaScript, but are wrapped up by a framework that can be made into a downloadable app. These hybrid apps have resulted in more cost efficient solutions, improvements in mobile hardware to have better web rendering engines and still provides access to users accessing the app via traditional desktop computers.

Over the next 5 years the ATO should monitor the enterprise application market for improvement opportunities in areas like Business Intelligence (BI) and Client Relationship Management (CRM).

Tools

Rapid changes in the digital space have led to the development of more efficient, easier to use coding tools. The main two avenues in which the developer tools have been improving is the ability to develop cross-platform solutions and increasing the efficiency of tools where less work effort is required to produce the same results.

Developers have realised that for them to keep up with demands it is no longer profitable enough to create basic apps for a single platform only, therefore developers are catering to consumers who are looking for developers to follow agile development standards with quick turnaround times and to cater to all popular mobile platforms. The downside to cross-form apps is that they are not capable of taking advantage of specific differences in the operating platforms, thus creating a less rich app experience. Native Mobile apps can utilise all aspects of that platforms capabilities like specific hardware and software[50].

Rapid Mobile App Development (RMAD) tools have greatly increased efficiency in app developing as it utilises either low-code or code-free programming tools to speed the process of creating apps for mobile platforms[51]. These RMAD tools can have a variety of functions, including drag-and-drop codeless tools, code generation and orchestration tools, model-driven development tools, virtualisation tools and form construction tools.

RMAD tools are used for the creation of native mobile apps, however newer technologies are beginning to break through now that may tear down the barrier developers face with providing either a rich native app solution or a less complex cross platform solution. React Native is a new (first release on 26th of March 2015) tool developed by Facebook where a developer could make a native app for multiple platforms (currently iOS and Android only) as it generates a native app controlled by JavaScript. James Long, an influential Mozilla developer, commented that "…it completely reinforces the fact that REACT.js is the right way to build apps. I can write a native app using the same techniques as I would write Web apps"[52].

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[47] 5 Trends That Will Influence Mobile App Development in 2016 Dynamic Leap
[48] Op Cit. Gartner, by Susan Moore
[49] ATO internal reference
[50] Mobile Web Apps vs. Mobile Native Apps: How to Make the Right Choice on Lionbridge website
[51] Discover low code rapid mobile application development Alpha software website by DaveMC.
[52] First Impressions using React Native by JLongster website.

The ATO might consider whether investing in some advanced RMAD developer tools would be beneficial in its software development mix. The ATO should consider leveraging procurement of software particularly in areas of complexity and cross-platform compatibility.

Citizen Development

"The shortage of skilled mobile developers to meet the ever increasing apps demands has led to 'citizen developer' initiatives"[53]. The demand for enterprise mobile app development has continued to rise and organisations are adopting the paradigm shift to allowing less skilled staff to fill the widening demand gap. The take up of mobile Rapid App Development tools has enabled ordinary business users to create their own solutions by embracing low code platforms for citizen development.

Research director at Gartner expects citizen development efforts to expand significantly over the next 5 years. A key reason for this is the accelerating enterprise use of cloud-based software platforms that allow citizen developers to access corporate data more easily than data stored on servers in corporate data centres controlled by the ICT department.

Generally apps that make people's jobs easier by automating a process are the most suitable for citizen development. Technology empowers staff to no longer need coding skills and when it is accessible then it has been theorised that the people closest to the work are the best people to design the solution to a problem. A potential danger of promoting citizen development is assuming the platform used to create the app has taken into consideration all regulatory or compliance issues.

Another setback can be the formation of a 'Shadow ICT' environment where the ICT department is no longer in the loop and notified when new solutions are integrated into the work environment. Some citizen developers can become too eager to streamline their business processes and completely ignore or omit including their ICT department[54]. ICT departments are encouraged to educate the wider enterprise on the benefits and risks to try to curb citizen development behaviour away from shadow IT.

The ATO could leverage staff knowledge of business processes and in a coordinated way provide staff with an RMAD tool capable of creating solutions. A coordinated approach is likely to reduce the potential formation of a 'Shadow ICT' environment.

App security

A larger focus on mobile app security is expected in 2016 and beyond, coinciding with increased demand for enterprise apps. Gartner predicted that more than 75% of mobile apps failed basic security tests in 2015[55]. Enterprises that have adopted the BYOD policy are generally more vulnerable to security breaches unless thorough mobile security testing is undertaken.

Common combatants to this security shortfall include the use of Static Application Security Testing (SAST) and Dynamic Application Security Testing (DAST). SAST provides a security scanning of the apps source code or binary, which is the bottom level language or foundation of the apps. SAST is considered a useful comprehensive and efficient approach however where SAST falls short is a high number of false positives and an inability to test apps in their real environment. This is the security void where DAST bridges the gap, testing apps externally whilst the app is running. The DAST also has its own limitations including false-negatives (missed vulnerabilities).

Interactive Application Security Testing (IAST) is generally considered the more reliable testing method by attempting to leverage the advantages of both SAST and DAST. From a practical view the implementation of an

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[53] 3 Trends Shaping Mobile Development in 2016 Adtmag Website
[54] Can citizen developers bring shadow IT into the light? On CIO website by Paul Rubens
[55] Gartner Says More than 75 Percent of Mobile Applications will Fail Basic Security Tests Through 2015 Gartner website

IAST solution is not an easy task, having being compared to crossing a hedgehog with a snake[56]. IAST engines cover more code, produce more accurate results and verify a broader range of security rules than either SAST or DAST tools do individually, however developers are still looking for a more accurate, comprehensive and efficient testing tool and the general lack of app security scrutiny has led to an underdeveloped market segment (enterprise apps) whereby security is more paramount of a concern.

Both Apple and Android have been hard at work patching and upgrading their mobile operating system's security and they're urging app developers to do the same. Experts have stated it is unlikely a whole industry of app security experts will emerge, however app developers will likely invest more into security measures going forward.

The ATO is understandably vigilant on the security of apps that use our clients' data. The ATO may wish to closely monitor app security advancements to see if the Software industry manages to provide satisfactory security assurances.

Use of APIs

API trends

Application Programming Interfaces (APIs) are defined as a set of functions and procedures that allow the creation of apps which access the features or data of an operating system, app, or other service. It is a rapidly growing market segment with most API businesses starting within the last 5 years and heavily invested in providing mobile API support. It is predicted that the API management solutions market will quadruple by 2020[57].

The biggest drivers for APIs are the growing demand in the Mobile market as well as the rise of IoT, which coincides with government BYOD policies. Enterprise integration and digital security are smaller drivers that are expected to dramatically gain mainstream attention and become more important in the API economy. DevOps has been widely adopted by API producing entities and government agencies may benefit in its dealings with Software developers by embracing DevOps.

API progression

APIs are one of the building blocks that will give rise to the success of the IoT as an organisations core assets can be used, shared and monetised through APIs that can extend the reach of existing services through concepts of openness, agility, flexibility and scalability. These concepts are moving from luxuries to necessities, and the culture and institutional inertia may be hurdles for the API economy. The State of API Report 2016 is a comprehensive view of the current API environment, stemming from developers opinions from around the world.

Nexus is the company that is facilitating the improvement to the New Zealand Government's discovery, processing and information base of APIs by cataloguing all of the government's APIs. Agencies do not currently have a channel for companies to request API information from government agencies and Nexus stated that the main challenge identified preventing progression around APIs is the culture within agencies[58.]

Nexus hopes to tackle the culture hindrance by way of increasing discovery of government APIs, the implementation of a process to manage the request of APIs and an increase in agencies access to information,

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[56] How to reveal application vulnerabilities? SAST, DAST, IAST and others PT security website
[57] The API Management Solutions Market Will Quadruple by 2020 as Business Goes digital Forrester website by Michael Yamnitsky
[58] R9 Accelerator - Nexus Marketplace Youtube posted by Ministry of Business, Innovation and Employment (NZ)

via APIs, to instil trust in decision making. This presentation was the product of the New Zealand Government Better for Business program which was mentioned in an Australian Government report.

The report for the Australian Government was produced by the National ICT Australia Limited Company and outlined a number of recommendations for the Australian Public sector to enable business to government digital interactions. One of their recommendations states that the Australian Government's operations and agility would be greatly enhanced through the adoption of APIs as the preferred method for exchange of information both between government agencies and all external organisations. Telstra appointed API Evangelist Frank Arrigo stated in a 2015 article that "In five years' time, I believe every organisation will have an API. It's an inevitable outcome, but I don't think Australian businesses realise that yet." [43]

The United Kingdom is beginning to implement changes for the impending API market segment flourishing, where some government agencies are using data.gov.uk to publicly share APIs, so far with Health and Transport sectors currently online. The UK has also developed some guidance around building, consuming and using APIs on their government website.

The ATO already releases the API for developers impacted by the SBR project, however not publicly. The ATO might consider releasing it publicly and foster an environment of citizen development for software to specifically interact with the government's SBR system. The ATO should encourage Gov.au to share API's in a similar way to the UK.

Other digital services

In the United States Accenture did a survey resulting in 92% of citizens stating that improved digital services would positively impact their view of the government, and 72% stated expanded digital services would both increase their overall satisfaction with the government and increase their willingness to engage[59]. Countries are progressing at different rates when it comes to digital services; however there are also a number of similarities between what digital services are being provided. See **Figure 1.** for further information.

Figure 1. Digital Services form key comparable jurisdictions

	Tax E-portal	Single touch government interactions	Data.gov	API public access
U.S.	Yes	No (IRS yes)	Yes (CKAN based)	Yes for data, plus others[60]
U.K.	Yes	No	Yes (CKAN based)	Yes for data
Singapore	Yes	In progress, OneInbox[61]	Yes (CKAN based)	Yes for data
Australia	Yes	In progress, MyGov[62].	Some agencies (CKAN based)	Yes for data and SBR developers
Canada	Yes	No	Yes (CKAN based)	Yes for data and other government software
New Zealand	Yes	No*	Yes (not CKAN based)	Yes for data

[59] [Accenture Survey Shows U.S. Citizens Want More Digital Services from Their government](#) Newsroom website on Accenture.
[60] [Other APIs](#) provided by U.S Government
[61] [OneInbox](#) – Singaporean Government
[62] [MyGov](#) – Australian Government

*Please note: New Zealand have implemented One Voiceprint for many agencies, however is yet to develop a single touch government portal for citizens.

Overall there is a clear transition happening in the digital services space for government agencies and with the change of culture towards embracing open data, changing procurement policies (including allowing them to be more agile once created) and continuing to widen the conversation to include all valuable stakeholders. Open data is just the beginning to governments providing digital transparency to the general public via APIs and the momentum is heading towards releasing APIs for interaction with all government software as APIs are the digital glue that connects all different services to one another[63]. GovHack, APIdays and CeBIT are examples of quality filled conferences for government to gain a better understanding of the current Software industry environment.

IBISWorlds Industry Reports support a plethora of data to gauge Australian industry stability. For the Software industry[64] it outlines key economic drivers, supply industries, demand industries and any related industries for each market segment. The comprehensive information could be leveraged for multiple purposes; an industry health check or understanding the major companies that influence particular segments or understanding what products are being marketed. The table on the next page below (**Fig 2**) presents a view of IBIS world's Australian Software industry reports with their rates of growth and key economic drivers.

The ATO is likely to continue to see a benefit from sending representatives to annual software related conferences like GovHack[65] or APIdays[66]. The ATO subscribes to IBISWorld website statistics and may wish to monitor this data to assist with benchmarking or identifying key stakeholders that influence certain market segments. The ATO could leverage this data when it comes to auditing taxpayers to gauge insight into the industry, thus providing tailored and well researched response to tax claims.

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[63] The rise of API-ification within the Australian and New Zealand start up ecosystem Startup daily website by Mat Beeche
[64] Software industry reports by IBISWorld
[65] GovHack
[66] APIdays; Platforms for innovation

Appendix 1 - IBISWorld sub-industry details

Figure 2. Comparison of growth, market share and drivers across related industries [67]

Click market segments below for IBIS world details;

	Annual Growth 2011-2016	Annual Growth 2016-2021	Industry Life Cycle	Key economic drivers
Computer System Design Services	4.1%	3.8%	The industry is in the growth stage of its life cycle.	-Capital expenditure on computer software -Capital expenditure by the public sector -Business confidence index -Internet connections -IT and telecommunications adoption
Online Computer Software Sales	7.6%	3.1%	The Online Computer Software Sales industry is expected to be in the growth stage of its life cycle.	-Real household discretionary income -Consumer sentiment index -Demand from computer and software retailing -Internet connections
Software Testing Services	4.7%	2.3%	The Software Testing Services industry is in a mature stage of its life cycle, despite being so closely affiliated with other growing industries	-Demand from computer system design services -Capital expenditure on computer software -Business confidence index -Number of poker and gaming machines
Computer and Software Retailing	1.6%	1.8%	The industry is in the decline phase of its life cycle.	-Real household discretionary income -Demand from online shopping -IT and telecommunications adoption -Internet connections -Consumer sentiment index -Trade-weighted index
Software Suppliers[68]	4.3%	3.1%	The Software Suppliers industry is in the growth phase of its life cycle.	-Capital expenditure on computer software -Business confidence index -IT and telecommunications adoption -Demand from video game and recorded music retailing
Software Publishing[69]	8.3%	3.7%	The Software Publishing industry is currently in the growth phase of its economic life cycle.	-Capital expenditure on computer software -IT and Telecommunications adoption -Demand from computer and software retailing - Real Household discretionary income

[67] IBISWorld
[68] IBIS World definition:"Software Suppliers are primarily engaged in wholesaling computer software and the provision of services related to computer software. The industry includes the distribution of physical software and digital downloads and related after-sales service, but excludes the provision of consulting services".

[69] IBIS World definition: "Software Publishers create and distribute ready-made (non-customised) computer software".