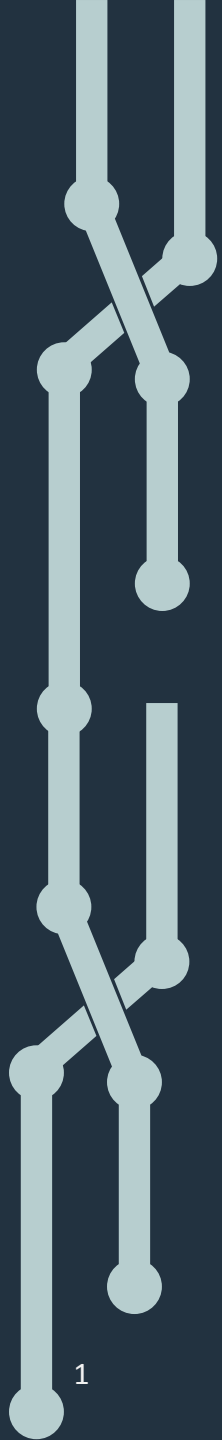Office for
National Statistics

Digital Services & Technology (DST)

Strategy (2019 – 2023)

2019

Digital Services and Technology - Introduction

- DST has gone through many phases of change transforming the old DTM Directorate into a new Digitally focused and technologically advanced Directorate.

- We have driven ONS forward over the last four years and totally transformed the way we work.

- This journey is not over. As technology advancement continues at pace it is paramount that we stay ahead and don't sit still.

- In the next five years we will push ONS forward to be at the forefront of all statistical insight and data science for both the GSS and internationally.

- At the heart of what we do is our purpose. Being clear on our purpose will help us to achieve our ambitions and strategic outcomes.

Our purpose – enabling innovation at speed and scale to keep ONS at the forefront of providing data, statistics and insights which matter.

As a trusted partner we work collaboratively with the business, continually scanning the technology landscape, identifying leading edge technologies and using them to deliver innovative technical and digital solutions which meet ONS needs.

- This strategy document will be updated annually and our strategic intent and objectives will be reviewed regularly throughout the year at leadership meetings to ensure we remain on track

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We have adopted a collaborative approach to devising and setting out our Digital Services and Technology strategy

Initial DST leadership meetings to set overall strategic direction and initial draft of the strategy

Secondary research conducted identifying market changes and technology advancements

Meetings held with DST Senior Managers to challenge and validate the strategy

Interviews with key business stakeholders to test the strategic ambitions and direction

Focus groups with staff from across DST and the business to test elements of the strategy, with particular focus on the DST purpose, approach and strategic outcomes

An updated version of the strategy which incorporates the feedback and challenges received. This ensures that our strategy is more robust as a result, although we recognise that ongoing engagement will be key in its delivery.

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We also identified some key strategic drivers which shaped our strategy..

External Drivers

Technology
- To be able to act quickly in the face of rapid and significant advances in technology and to be at the leading edge of technology change
- To ensure the technology estate is fit for purpose in the future

Data
- To ensure we have the technical capability to provide a wealth of readily accessible data
- To provide technology systems which ensure all data is secure by design
- To consume the growth in open and transparent data

Digital
- To be able to deliver digital solutions and services with a fully flexible and dynamic approach
- To provide technologies which enable data collection and dissemination via user centric interfaces
- To be able to make use of new and different data sources

Society & People
- To keep apace with the changing workforce demands ensuring we are an employer of choice
- Our technology choices will need to be ahead with societies ever growing "data appetite"

Internal Drivers

ONS Strategy
- To provide a DST strategy which helps to deliver the overarching ONS strategy

Business Needs
- To work collaboratively with the business on the project delivery of digital solutions to meet business requirements
- To be able to support the business by the provision of services which are key to day to day operations

Cost & Efficiencies
- To be cost efficient and ensure value for money
- To use advances in technology to continually improve our efficiency and effectiveness

Collaboration
- To provide and develop services which can be shared with other Government departments and internationally
- Seek to consume services made available from other Government departments

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This has led us to focus our Strategy on the delivery of four key outcomes...

STRATEGIC OUTCOMES

Highly capable digitally skilled workforce

Our dedicated people are core to DST in our ability to deliver value for ONS. We will develop all our staff and expose them to all the latest advances in technology and digital. We will recruit staff by reaching out to schools, universities and through apprenticeship schemes as we make ONS the place of choice to work in digital and technology. We will become a centre of excellence in government and establish academies in the latest technology and digital skills

Efficient automated operational processes

As we move increasingly toward the Cloud we need to look at our support processes and where possible we need to move to Evergreen technology that is utilising a continuous improvement and development cycle to provide a seamless service to our users. We will automate repetitive tasks and provide self-help facilities for regular tasks for our users. This in turn will free up our staff to develop their skills in more in-depth technologies.

Flexible and adaptive delivery methods

We will continue to use agile as our driving principle in everything we deliver. We will continue to promote agile ways of working and work towards building a prioritised backlog to support the evolving needs of our business. Utilising technological advancements, we will move away from physically co-located teams to enable virtual teams to work together where location is not a barrier to successful delivery.

Robust leading edge technology

We will aggressively move towards a cloud-based ecosystem, ensuring that we are at the leading edge for all our new technology developments. We will ensure all our services are using tried and trusted technology platforms with security built in from the start. With systems that are flexible enough to meet the changing needs of the business and the wider environment.

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How will we achieve these outcomes...

- To successfully deliver we need to ensure that we have a consistent message and a consistent approach.

- We all need to keep in mind the wider context in which we work, listen to our users needs and to try things out incrementally but at a pace that makes a difference.

- This means that all our work should follow the approach as outlined on the following slide

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THINK BIG – DO SMALL – ACT FAST

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What does our approach stand for?

THINK BIG — DO SMALL — ACT FAST

We believe that the bigger our ambition, the more we will achieve. We will not be constrained by what's possible today, instead we will consider the full range of futures and opportunities

We think that by breaking tasks down into smaller chunks, we will be more likely to deliver quick wins and succeed on our path to the big thing.

We know that the faster we act, the faster we learn, from both our failures and successes. We will feed our findings back to continually improve.
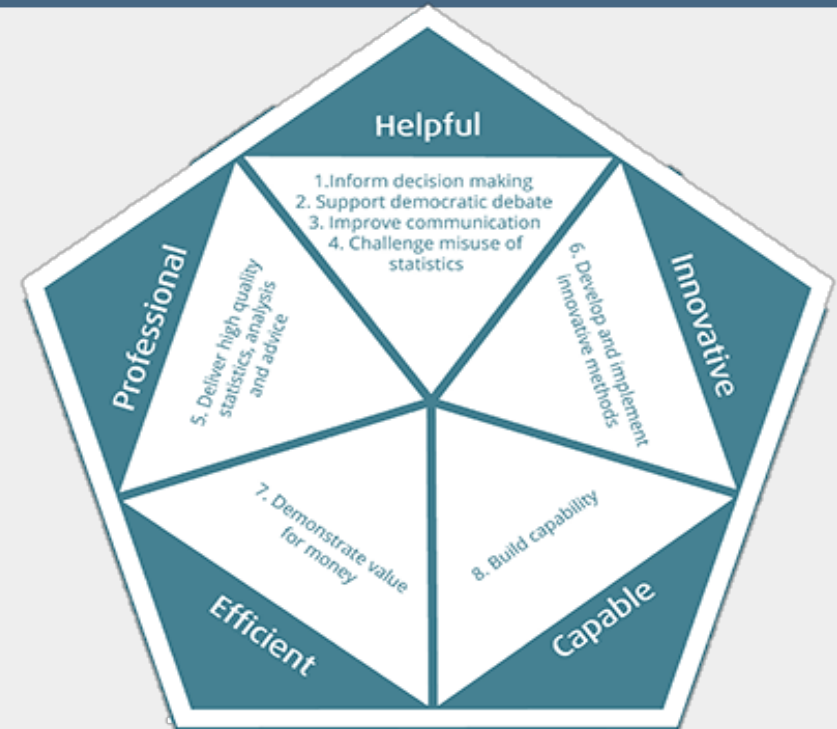
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We are confident that our strategy and approach will help to deliver the overarching Office Strategy …

Better Statistics – Better Decisions

ONS is the largest producer of official statistics, and is the only Government Department which has that as its main role. **Our statistics drive decisions made across the country**.

ONS is a data driven organisation. The data and statistics it provides are at the centre of UK policy and decision making.

To enable ONS to achieve its strategy our **technology and systems** will need to adapt to process new and diverse data sources more quickly and effectively than ever before.

Helpful
1. Inform decision making
2. Support democratic debate
3. Improve communication
4. Challenge misuse of statistics

Professional
5. Deliver high quality statistics, analysis and advice

Innovative
6. Develop and implement innovative methods

Efficient
7. Demonstrate value for money

Capable
8. Build capability

Our purpose – enabling innovation at speed and scale to keep ONS at the forefront of providing data, statistics and insights which matter.
How - As a trusted partner we work collaboratively with the business, continually scanning the technology landscape, identifying leading edge technologies and using them to deliver innovative technical and digital solutions which meet ONS needs.

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We have a clear plan in place to deliver on the corporate business plan and we will continue to commit to the delivery of this plan...

The deliverables listed below, and on the following page, are those outlined in the Accountability Framework. Progress against these deliverables is reported on a monthly basis. In addition, there are several deliverables outlined in the DST Medium Term Plan. All deliverables in the medium term plan are tracked in the monthly DST Delivery Board.

Helpful

- Deliver a learning pathway for DAP users encompassing first awareness through to advanced use and expert advice
- Establish a DevOps culture and create a self service model for Service Desk

Innovative

- Capability to enable full automation for the ingestion of data from supplier to prepared, linked and ready to use within DAP delivered
- DAP : Capability to design and run data processing pipelines utilising a central Statistical Methods Library
- Capability to facilitate Census Collection Rehearsal processing requirements
- Capability to facilitate Census Processing Rehearsal
- Deliver DAP capabilities in Public Cloud with secure data exchange with existing DAP
- Devise a Global Data Platform on behalf of the United Nations
- Survey Data Collection: SDC products and services for Census, proven and in line with scalability / volume requirements for Census rehearsal in October 2019
- Move more economic surveys (translate only) online using existing capabilities of the Survey Data Collection platform (SDC)

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We have a clear plan in place to deliver on the corporate business plan and we will continue to commit to the delivery of this plan…

Professional

- DAP : Introduce the capability to design and execute business workflows and manage contributors
- Deliver Acceptance into Service of DAP
- Launch Data Capability's ONS Data Service

Capable

- Enhanced corporate desktop (inc. Windows 10)
- Contact centre migration
- Introduce Skype connectivity
- Additional functionality to concierge (e.g. room bookings)
- Develop ONS reference architecture and governance process
- Ensure that DST products and platforms meet the scale required for Census rehearsal

Efficient

- Complete full migration of CDME to DAP
- Complete migration of SRE to DAP
- Solution Architecture to support 2019 Census rehearsal finalised and agreed
- Develop solution Architecture for key CDCTP 2021 deliverables
- Legacy uplift - replace legacy applications technology
- Secure Research Service shopfront available for researchers to apply for accreditation
- Secure Research Service platform alpha build complete

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GDS principles, along with our strategy and technology principles will continue to guide decision making as we work towards our long term goals ..

We will ensure that we will comply with the below principles:

- GDS Design Principles
- Technology Code of Practice
- Digital Service Standards
- Open Standards Principles
- Data Principles
- Security Principles

In addition, we will comply with the following principles which are specific to DST:

Ways of working – We will work together across the Directorate, ignoring divisional boundaries to meet business needs and the wider government agenda

People – To develop our staff in order to have a wide skill set and specialism in key areas in order to minimise our dependency on long term contractors

Leading Edge – Our aim is to be leading edge and so we are committed to being early adopters and will deliver at pace. We will meet todays needs whilst ensuring our solutions are also fit for the future

Technology - To be Cloud Native and to use open standards and open source where possible

Architecture – We will adhere to our architecture principles as defined

Assurance – We will work to the guidelines as outlined in our governance and assurance framework

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Highly capable digitally skilled workforce

Our people are key to our success - we will focus on our existing staff whilst also recruiting the talent of tomorrow

The challenge

Our strategy involves considerable change and an uplift and reskilling of our staff…

Staff are rightly demanding more from their employers in terms of the overall work experience…

Our hypothesis is that ONS is not viewed as the place to work for IT professionals…

Research has shown that there is limited diversity in STEM areas, which includes IT professions….

Our response

We will continually invest in our people to re-train and promote …

We will improve wellbeing and focus on a welcoming and safe environment…

We will ensure that ONS is a desirable destination for those seeking a career in IT…

We are committed to challenging existing perceptions of careers in IT…

Our focus

- Continuing to develop and revise our Learning Pathways and Career Pathways (Inc. aligning to the new DDaT roles)
- Giving greater support and challenge to our Communities of Practice
- Encouraging more movement within DST to gather skills and experience
- Embracing a higher attrition rate if it is the right opportunity for the employee
- Ensuring we are using supplier partnerships to augment our technical skills and delivery capability in a specialist capacity

- Putting Wellbeing at the centre of a number of initiatives and activities to ensure that there is more to DST life than delivery
- Providing a formal mentoring and coaching framework
- Investing in technology to enable more flexible working patterns
- Investing in our office to create creative and effective workspaces
- Creating a culture where we know how what we do brings benefit – the purpose of what we do
- Reaffirming and giving greater clarity about our digital transformation

- Creating a Centre of Excellence for Digital and Technology
- Raising our profile in the digital industry locally and nationally
- A greater emphasis, on amongst other attributes, our new technologies and our non technical attractions such as flexible working
- Providing a clear Learning Pathways for those new to DST (in addition to the learning pathways for existing staff)

- Creating relationships and outreach type programmes at the local level with primary, secondary and tertiary educational establishments
- Making diversity at the centre of our recruitment
- Be bold in our choice of new sources of talent e.g. back-to-work programmes, apprenticeships etc
- Be innovative in our styles of working e.g. look at how we can make job sharing work in DST, flexible working from home etc.
- Recruiting for potential and investing in the future

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Efficient automated operational processes

We will deliver effective operational support to our business with the use of automation
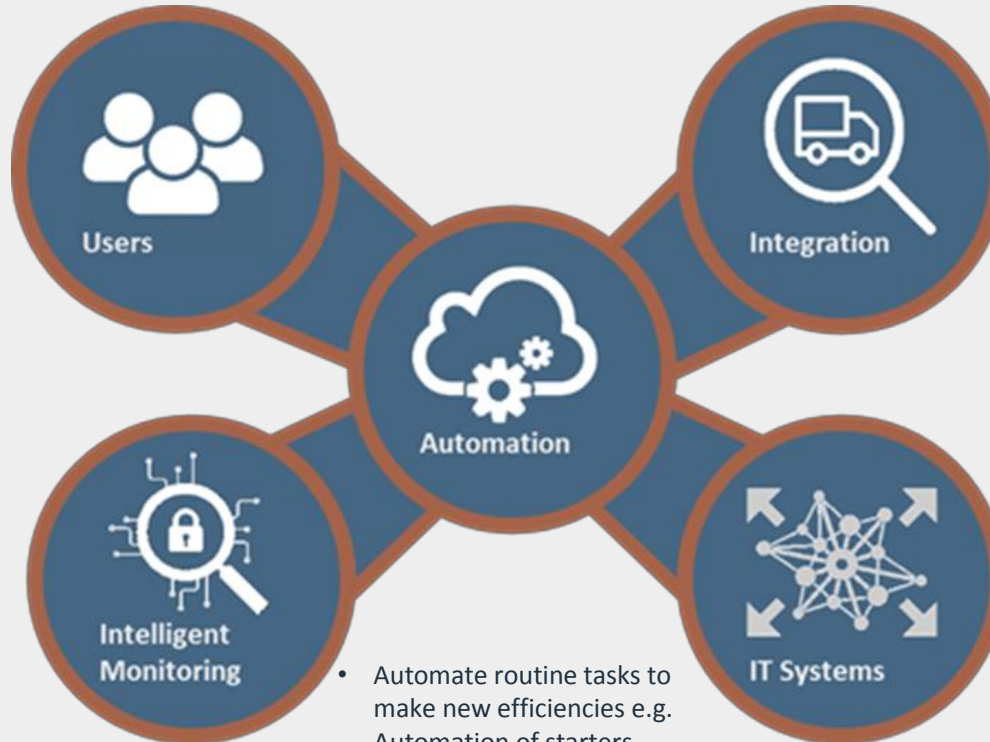
- Focus on improving user experience
- More targeted staff training
- Investing in deeper integrated tools to deliver greater flexibility to end users through self service offerings e.g. self-service password resets

- Intelligent proactive monitoring using SPLUNK to monitor real-time application performance
- Greater use of Machine Intelligence to improve system efficiencies and performance with all non-functional requirements e.g. Automation of tasks using Service Now modules e.g. software installs, server restarts

Users

Integration

Automation

Intelligent Monitoring

IT Systems

- Automate routine tasks to make new efficiencies e.g. Automation of starters, leavers and movers processes
- Embrace the opportunities that automation allows to develop Operations Staff in the new technologies and products requiring support e.g. Cloud Administration

- Common strategies across Software Engineers and Operations teams for development / testing / deployment e.g. DevOps
- Reuse deployment and testing patterns for building Applications and Services

- Drive the concept of Everything as a Service (EaaS) delivering enhanced productivity, greater flexibility and improved experience
- Automation of all aspects of Configuration Item management, improving compliance, efficiency and decision making e.g. Ansible for server builds, Jenkins for Continuous Integration, Service Now Discovery to improve quality of CMDB
- Create software defined services driving towards becoming supplier agnostic
- Focus on cost effectiveness

17

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Flexible and adaptive delivery methods

We will continue to use Agile methods to deliver on our business commitments ..

Current view ….

- We have adopted Agile methodology within DST and continually adjusting our Agile techniques to effective deliver business requirements
- We need to improve our understanding of linkages between projects so that pressure points are identified early on and acted upon
- We have set up product delivery teams but there are challenges to deliver quantity rather than quality project outcomes. In some cases this has led to an amount of re-work required
- We need to better define and enforce product management to make delivery more collaborative
- We need to communicate with the business to ensure greater alignment of priorities

Our intention….

- We recognise that as a business we need to reinforce Agile principles. We will:
  - Continue to ensure Enterprise Architecture optimises the use of resources to fulfil business needs in accordance with the priorities of the organisation
  - Have a combined product backlog, to understand dependencies and critical paths to achieving the ambitious
  - Seek external assurance of how we deliver and set ourselves the goal of being a truly agile development house
  - Investigate how we look more holistically across the entire delivery landscape and deliver outcomes more efficiently based on the full programme of development we have
  - Utilise our business partnership model to ensure key people from the business are embedded in product deliveries
  - Fully embed our new project office. The project office will provide data to DST to enable them to better communicate the priorities and rationale to both DST and the wider business

AGILE Approach

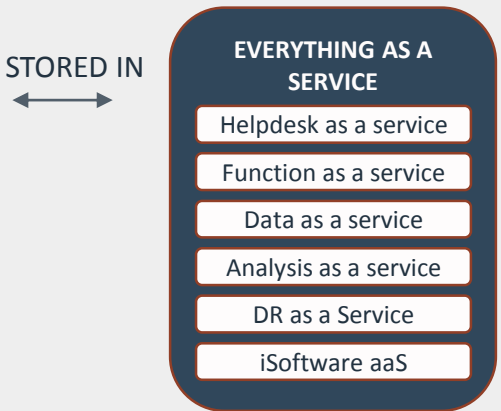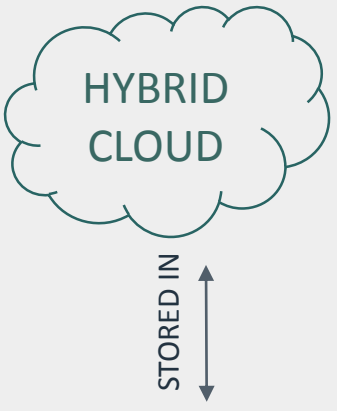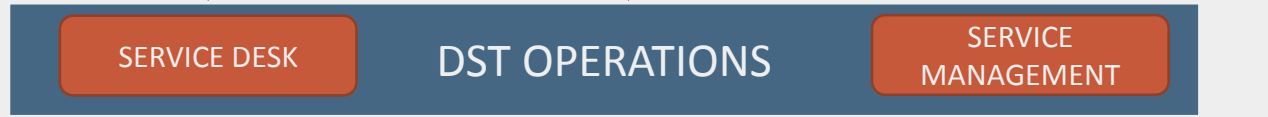Product Backlog → Sprint Backlog → User Stories → Sprint → Release

Sprint Execution — Daily Scrum

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Robust leading edge technology

Our future technology will meet business demands faster and more efficiently..
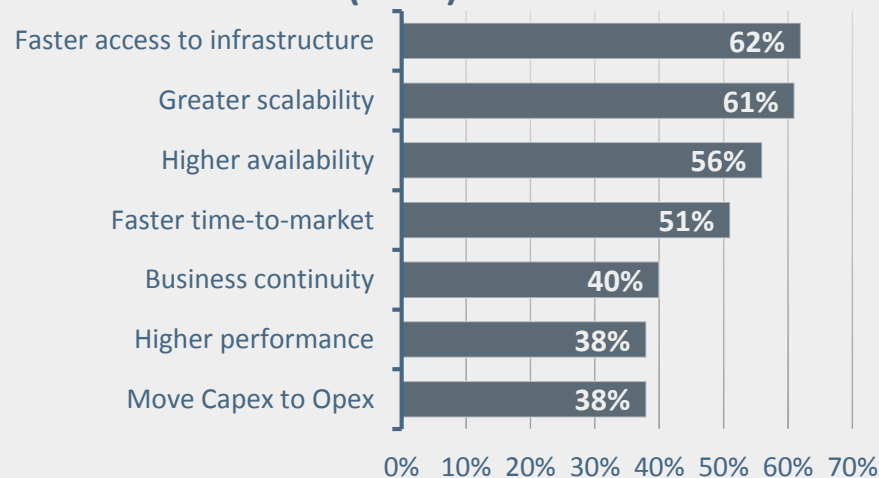
The key driver for utilising Cloud technologies is that there will be faster access to technology services and greater scalability.

This has key benefits for the business as DST will:

- Be able to scale resources to meet demand and subsequently reduce response time (e.g. Census)
- Be in a position to test out innovative solutions for the business with reduced overheads (e.g. SRS)
- Speed up development and incorporate feedback from users at a faster rate
- Be able to meet additional future demands from customers as Cloud is scalable
- Have greater mobility to switch Cloud vendors. This could lead to cost savings and have access to new services faster

Benefits of using Cloud computing (2017)

Benefit	%
Faster access to infrastructure	62%
Greater scalability	61%
Higher availability	56%
Faster time-to-market	51%
Business continuity	40%
Higher performance	38%
Move Capex to Opex	38%

0% 10% 20% 30% 40% 50% 60% 70%

Key challenges adopting cloud
- Ensuring that the cloud vendor is protecting critical information from theft, data leakage and deletion
- Concerns relating to a foreign country gaining unauthorised access to ONS data that is stored in that sovereignty
- Becoming reliant on a suppliers cloud services making it difficult to transition to another supplier
- Ensuring financial rigour and controls are in place
- Making sure our employees have the skills to deliver these new technology services

How we will overcome these challenges
- Ensure Government best practice security frameworks are in place with regularly reviews
- Information asset owners to make sure controls are in place and checks are completed
- Where possible, deliver solutions that are either vendor agnostic or where the lock-in is understood and mitigated
- Use reporting to regularly review financial spend and services that allow us to scale up or down to meet demand
- Investing in upskilling our staff and bringing in specialists where required

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We will continue our move to common platforms…

Enterprise Architecture Conceptual Solution Architecture
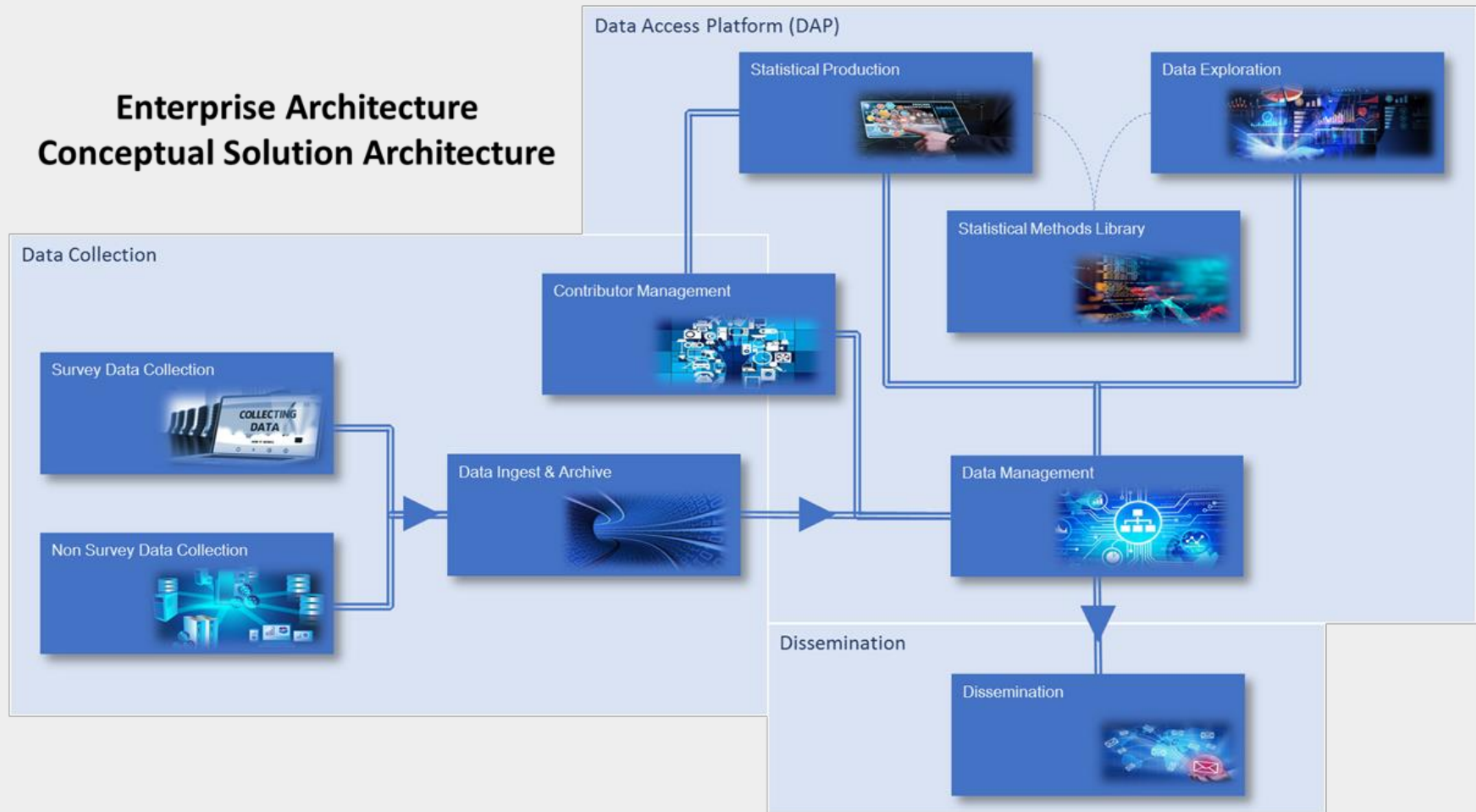
DST will continue to move away from siloed applications to a small number of generic to common platforms.

All statistical outputs will be processed through these platforms regardless of the type of output.

* https://collaborate2.ons.gov.uk/confluence/display/OSC/ONS+Service+Catalogue

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... and the removal of legacy will be a continued key focus

Robust leading edge tech

Digital Platforms

Transformed Business Processes

- Optimal business processes defined and delivered in common platforms

Meets Current & New Business Commitments

- Ensures user needs are continually met
- New requirements can be met fast and efficiently

Secure by Design

- Platforms designed to have security as a core component of its design

Optimal DST Support Model

- Core platforms which have resiliency built-in to increase availability and reliability
- Core technology which is leading edge and supportable

2020 Decommission Deadline

Legacy Platforms

Economic Statistics Processing

- In Alpha for Building Materials Index (BMI)
- Scoping the processing systems for Household Earnings (ASHE)

Social Survey Collection Systems

- New technology rollout for field based workforce
- Upgrading to Blaise 5 to reduce dependency on legacy applications

SAS Dependency*

- Uplift systems onto DAP processing where possible
- Gradual replacement of SAS components on CORD
- Switch from desktop to server based processing

Lotus Notes Removal

- Replacement of document stores with SharePoint
- Replacement of notes applications with SharePoint or commercially available Cloud based BPM products

*there will be elements of SAS for Census processing remaining post 2020

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How will DST embed it's Strategy?

Embedding and delivering the DST strategy...

- We do not want to have a strategy that ends up in some ones desk drawer gathering dust

- It is therefore essential, that the strategy is embedded and delivered with the support of all staff within DST. We have already started by gathering feedback on the strategy and have updated the strategy based on the feedback received

- The next stage will be to work on the high level road map with the DST Senior Managers

- This will be followed by a full and ongoing communications programme of activities, starting with a Town Hall event, to share the strategy with the wider DST Directorate

- Senior Managers will then be encouraged to devise more detailed roadmaps for their branches, which will subsequently be shared at a quarterly offsite with the leadership team

- Regular follow ups and quarterly offsites will be scheduled to check progress, share successes and challenge the strategy as appropriate, to ensure a strategy that remains robust and relevant

- In addition to the above, we will commit to updating the Strategic plan on an annual basis

A Continual Cycle

- Strategy
- Plan
- Do
- Challenge
- Refine

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High level roadmap

Financial Qtrs

2019			2020				2021				2022	2023
Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4		

Highly capable digitally skilled workforce

- Cross-government careers alliance in place
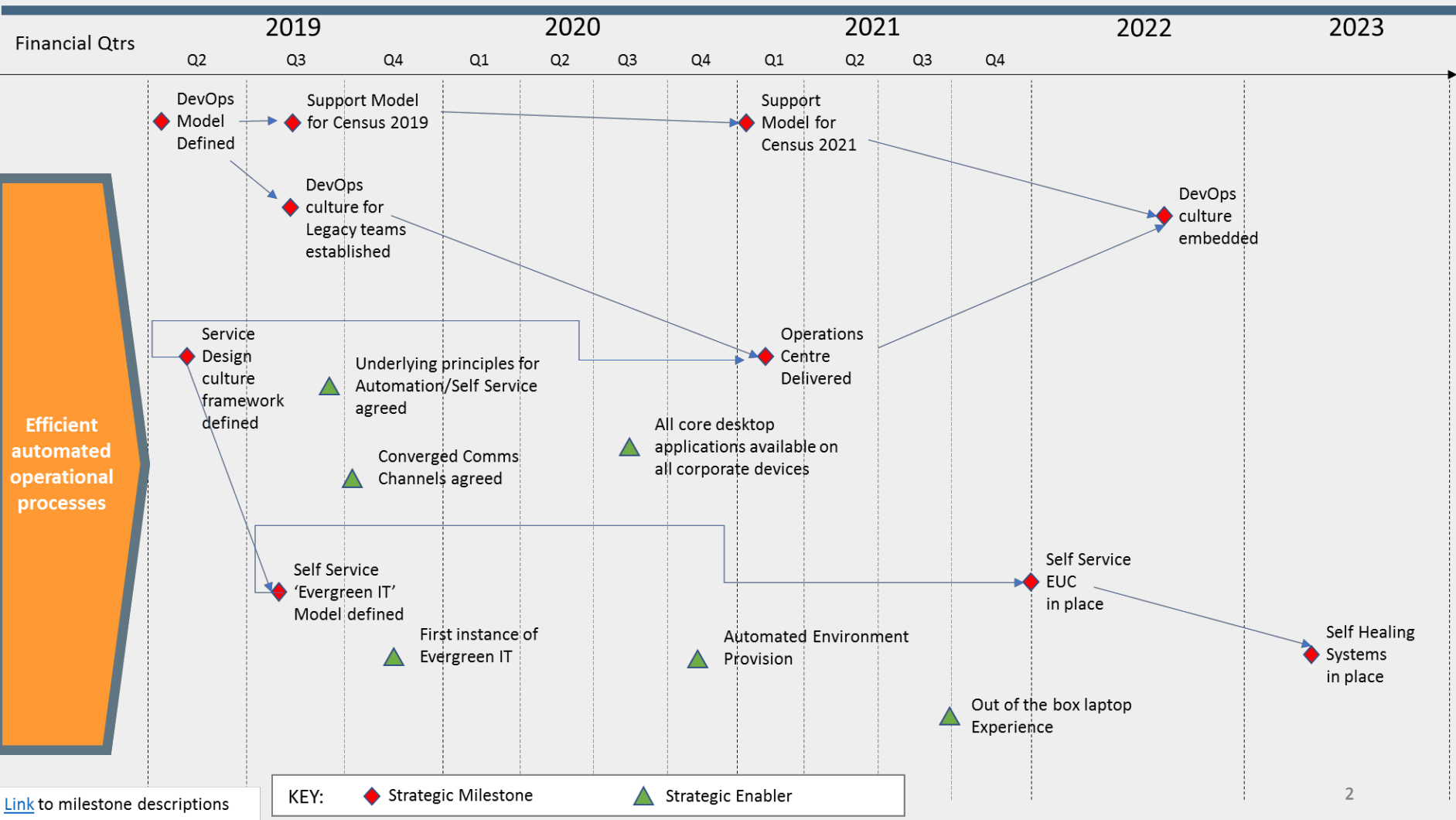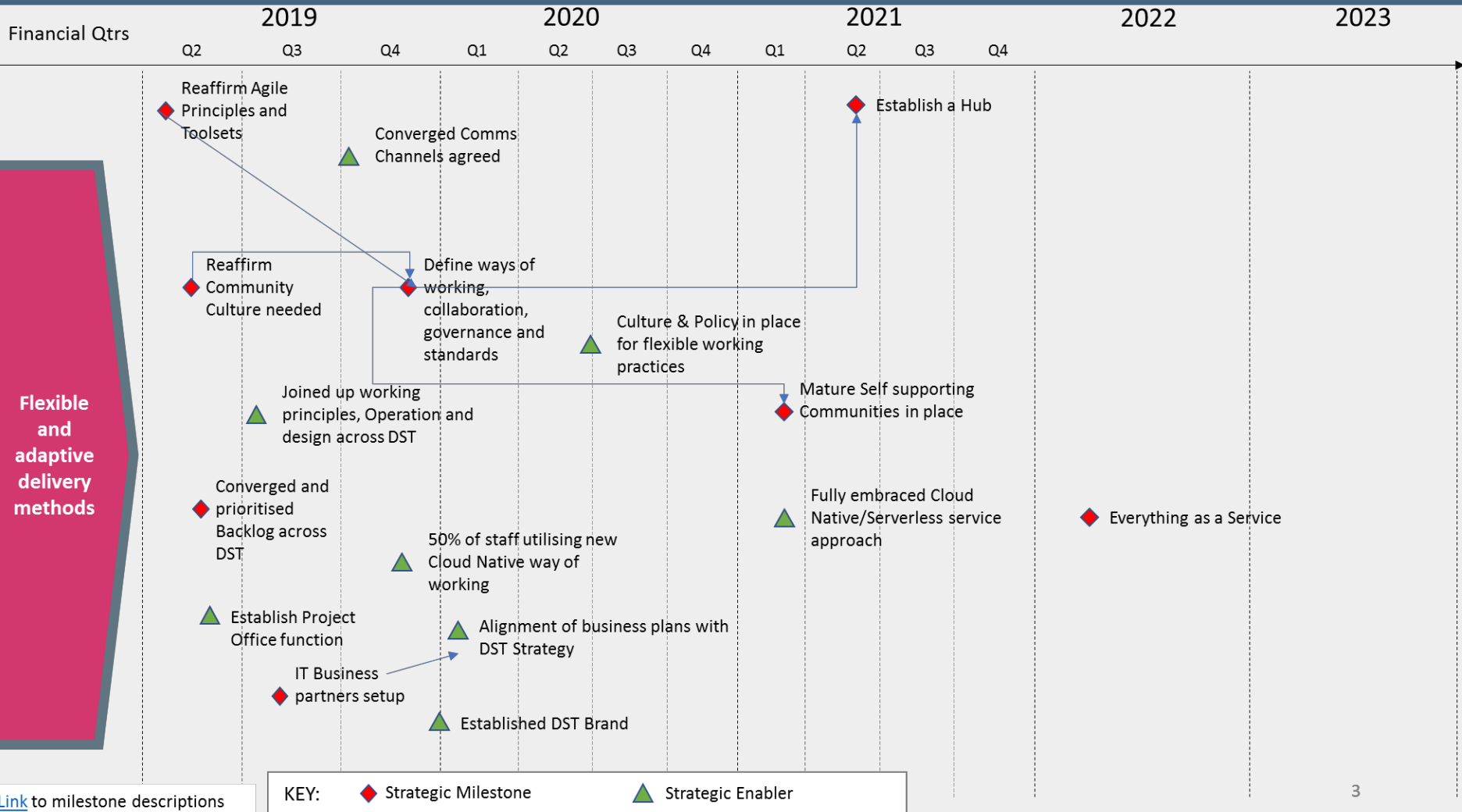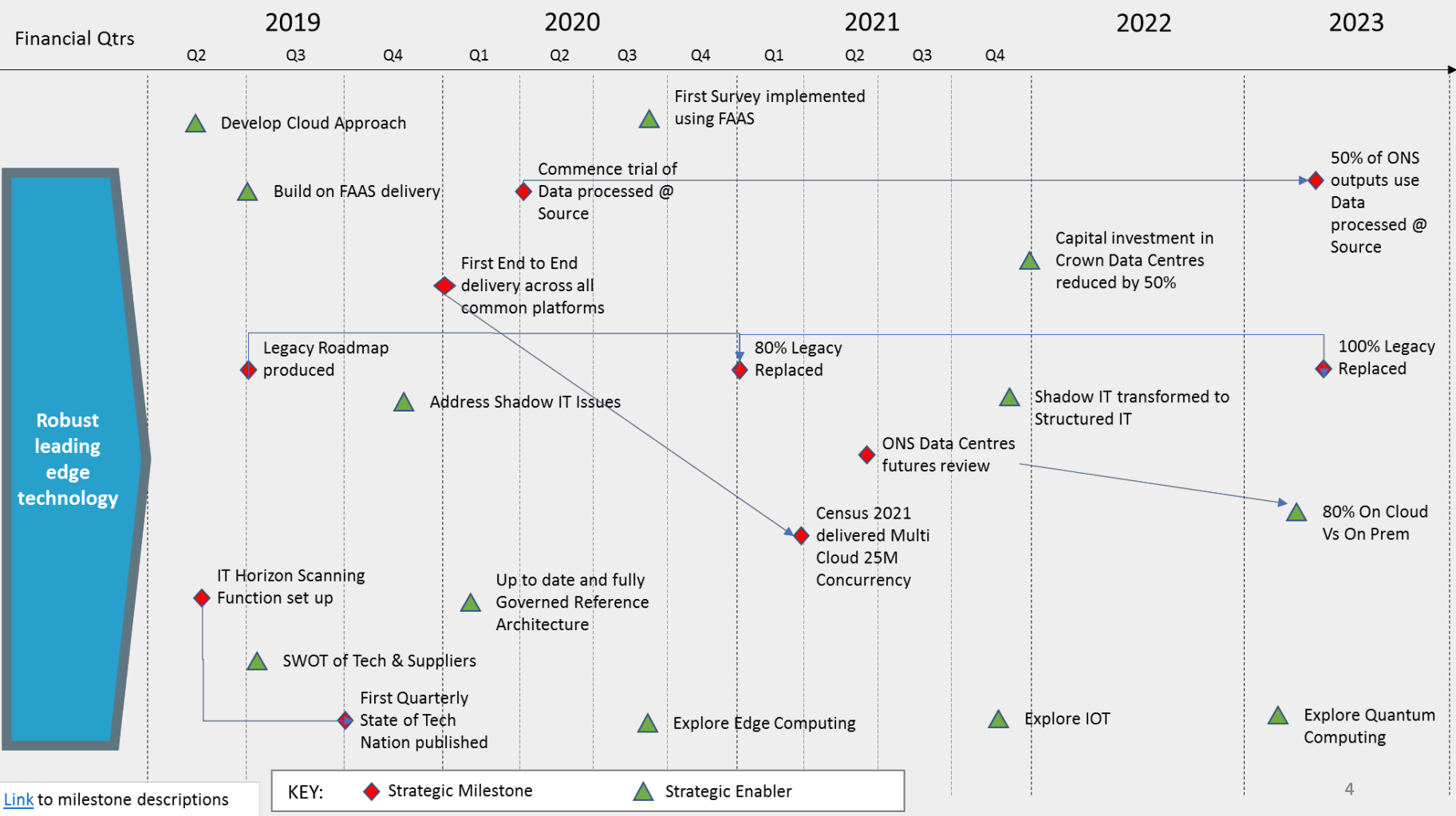- Career progression pathways are extended
- Career progression pathways are extended to cover all DDaT job families
- Permanent staff retention rates support wider strategy objectives
- Graduates are able to rotate between teams in DST
- All DST staff are able to rotate between teams in DST
- Workforce strategic progress review
- All DST staff have career progression pathways available to them
- DST staff have the opportunities to rotate out of ONS to undertake DDaT work in other government departments for defined periods of time
- Recruitment Plan agreed & in place
- Pay bands for all DDaT roles are harmonised across all government departments
- Right mix of permanent staff and temporary labour achieved through strategic recruitment activity
- Succession Plans in place for key DST roles
- Retention plan agreed & in place
- Creative and effective workspaces for leading edge and dynamic tech & people
- Communities of Practice defining standards and supporting individuals
- Learning pathways are in place for all DDaT roles
- Cross-government office 'hubs' are available to DST staff to work from
- External verification certifies ONS as an attractive career destination when benchmarked against other organisations
- External outreach activities underway
- International collaboration & knowledge development opportunities explored
- ONS recognised as a centre of excellence for digital and technology
- Prioritising learning and development is an inherent behaviour across the department
- Skills review complete for all DST staff
- Staff survey feedback actions
- Staff survey feedback actions
- All DST staff are able to identify the impact on them of the learning and development they have received
- Well-being initiatives in place
- Coaching and mentoring opportunities are actively supported and sought for all DST staff with a need

Link to milestone descriptions

KEY: ◆ Strategic Milestone ▲ Strategic Enabler

High level roadmap

High level roadmap

Financial Qtrs

2019			2020				2021			2022	2023
Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	

Flexible and adaptive delivery methods

Reaffirm Agile Principles and Toolsets

Converged Comms Channels agreed

Establish a Hub

Reaffirm Community Culture needed

Define ways of working, collaboration, governance and standards

Culture & Policy in place for flexible working practices

Joined up working principles, Operation and design across DST

Mature Self supporting Communities in place

Converged and prioritised Backlog across DST

Fully embraced Cloud Native/Serverless service approach

Everything as a Service

50% of staff utilising new Cloud Native way of working

Establish Project Office function

Alignment of business plans with DST Strategy

IT Business partners setup

Established DST Brand

Link to milestone descriptions

KEY: ◆ Strategic Milestone   ▲ Strategic Enabler
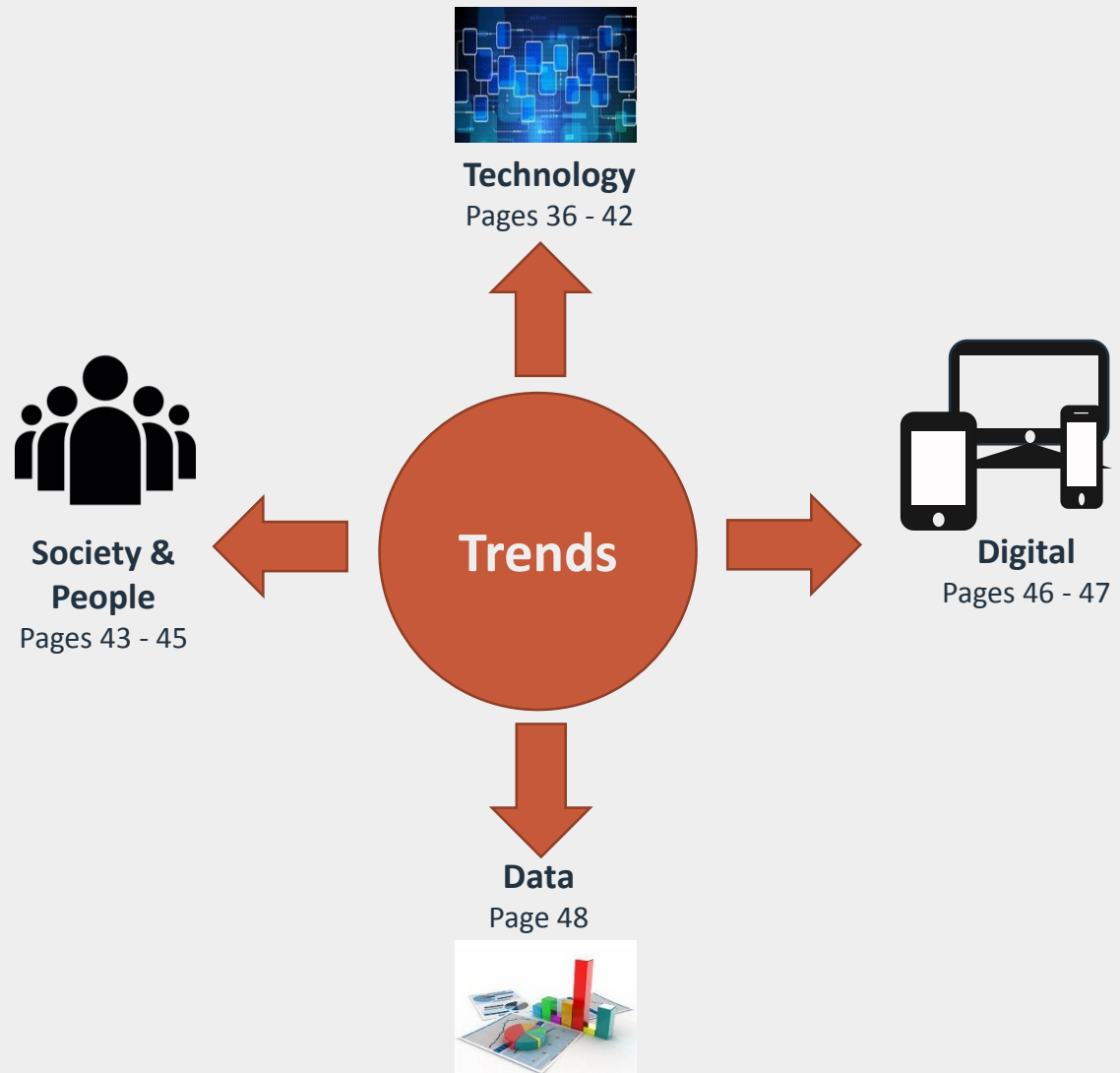
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High level roadmap

Appendices

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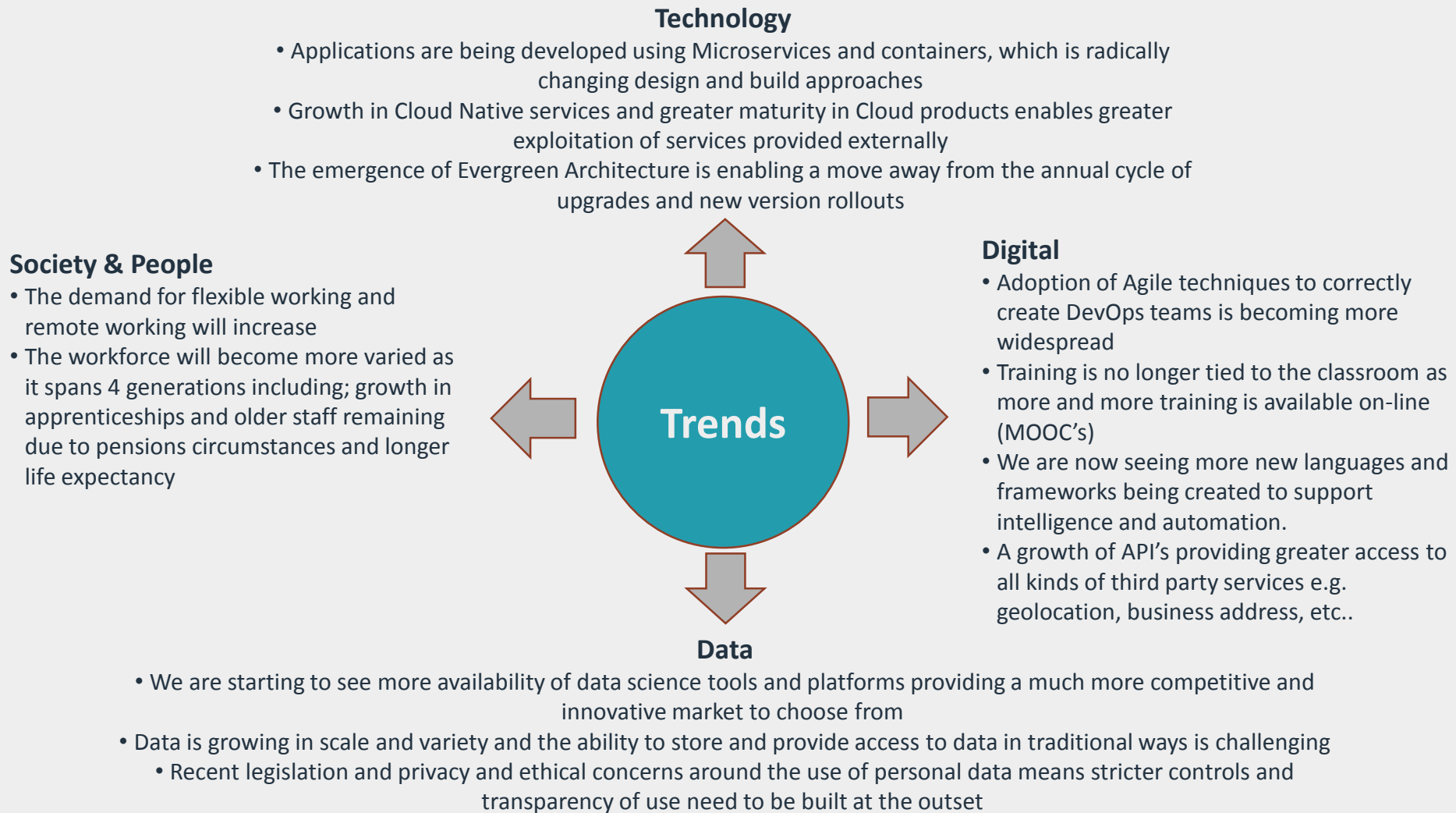
There are trends emerging in the market...

- We have conducted secondary research on market trends around the areas of:
  - Cloud Computing
  - Digital Trends
  - Data
  - Society & People

- Mainly, the research findings confirmed our current thinking

- The slides in this section summarise some of the research and support the rationale for the decisions and the technology strategy outlined in the main section of the report

Technology
Pages 36 - 42

Trends

Society & People
Pages 43 - 45

Digital
Pages 46 - 47

Data
Page 48

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There are trends in the external market and these are helping shape our DST strategy…

Technology
- Applications are being developed using Microservices and containers, which is radically changing design and build approaches
- Growth in Cloud Native services and greater maturity in Cloud products enables greater exploitation of services provided externally
- The emergence of Evergreen Architecture is enabling a move away from the annual cycle of upgrades and new version rollouts

Society & People
- The demand for flexible working and remote working will increase
- The workforce will become more varied as it spans 4 generations including; growth in apprenticeships and older staff remaining due to pensions circumstances and longer life expectancy

Trends

Digital
- Adoption of Agile techniques to correctly create DevOps teams is becoming more widespread
- Training is no longer tied to the classroom as more and more training is available on-line (MOOC's)
- We are now seeing more new languages and frameworks being created to support intelligence and automation.
- A growth of API's providing greater access to all kinds of third party services e.g. geolocation, business address, etc..

Data
- We are starting to see more availability of data science tools and platforms providing a much more competitive and innovative market to choose from
- Data is growing in scale and variety and the ability to store and provide access to data in traditional ways is challenging
- Recent legislation and privacy and ethical concerns around the use of personal data means stricter controls and transparency of use need to be built at the outset

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Containers - Future applications will be delivered faster and highly scalable with the use of container technology

Containers - What are they?
- A container image is a lightweight, stand-alone, executable package of a piece of software that includes everything needed to run it: code, runtime, system tools, system libraries, settings
- They start almost instantly and based on open standards which means they run on all the main infrastructures including Windows and Linux.
- As they are lightweight, multiple containers can run on the same server but treated as secure isolated instances.
- Container Management tools e.g. Kubernetes, tackle the challenges of coordinating container resources and workloads across server infrastructure.

Gartner estimate that By 2020, more than 50% of global organisations will be running containerised applications in production.

Container Technology– The benefits
- Developer changes can be committed and deployed almost instantaneously into a specific environment (CI/CD) triggering automated testing providing instant feedback.
- It supports a DevOps development strategy.
- Allows you to scale instantaneously to handle customer demand.
- Consistent environments resulting in consistent performance testing
- Easily portable to any container service i.e. public or private Cloud.
- Secure and isolated from other applications instance.
- It facilitates a high availability, multi Cloud policy, selecting private or public Cloud depending on security considerations.

Containers vs. VMs

Containers are isolated, but share OS and, where appropriate, bins/libraries
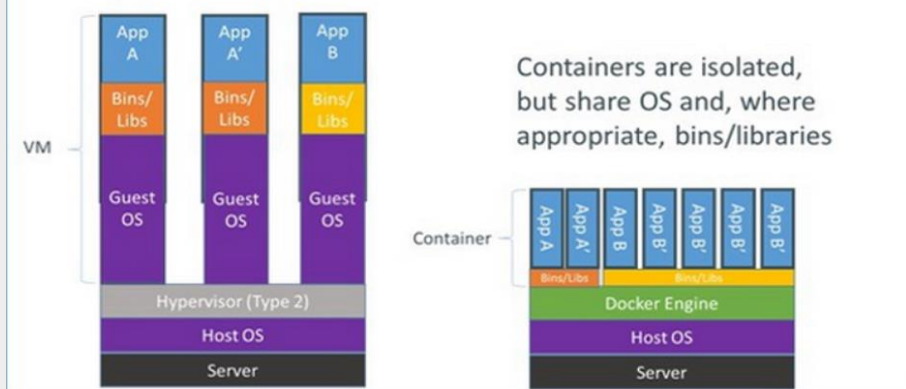
- As outlined in our Strategy, DST recognise the benefits of containerisation technology and are continuing to embed a DevOps model.

- Moving to a container technology will require changes in how teams deliver software e.g. canary and blue/green releases. Processes surrounding software changes will need to reflect this.

- Cloud management solutions will result in changes to technology in order to provision in multiple Cloud providers automatically upon demand or to ensure high availability. These are currently highly specialised skills with high demand.

- Applications will need continual management to ensure the correct environment is selected e.g. performance, security, costs. Micro services will mean more services rather than less.

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Containers - We are seeing a growth in management container 'platforms' and serverless computing.

Why Implement container management tools?

In order for staff to manage potentially several hundred production running containers effectively, and take full advantage of container technology as discussed on the previous page. A container orchestration engine (COE) is required.

Which Product to Select?

- There are several providers of container management tools in the market. The main products offered by these providers includes Kubernetes (K8), Docker Swarm and Mesos.

- Swarm is recommended for initial investigation of COE's but is deemed too basic for ongoing utilisation due to restrictions around scale-ability

- Deploying to industrial scale, advice suggests Kubernetes, whilst Mesos, which is used by the likes of Twitter and eBay can massively scale and is highly configurable.

- Forrester, in its predictions for 2018 says that *"Kubernetes has won the war for container orchestration dominance and should be at the heart of your microservices plans"*

- Kublr supports this and says that K8 *"...one of the most actively developed, feature-rich, and actively used platforms on the market"*

- However, it is still a relatively new technology and K8 has a steep learning curve. ONS are early in their adoption of containers and further work will be required to progress this element of the strategy and way of working

Serverless and Function as a Service (FaaS)

- Serverless computing is where the cloud provider manages the allocation of servers that host your containers , ensuring they are up to date, secure and can scale to meet demand

- AWS have introduced Fargate, this hosted service lets you forget about server provisioning. Instead you only pay for the time the containers are running

- Where a workload is dynamic and elasticity is important, this could be a good solution, such as surveys that have short time windows. Its predicted that this market will grow with more vendors offering competing products. Currently this is an expensive alternative

- Function as a Service (FaaS) extends this concept further. It could be used to process a specific task e.g. business validation checking. With the added incentive that efficient the code, results in a cheaper the service. All the three main vendors offer FaaS with AWS reportedly still out in front due to it's range of supporting product with Azure catching up

- Container Orchestration tools are the only way to efficiently manage containers.

- K8 is still a relatively new technology with a steep learning curve, which should be considered when deciding if to use a hosted platform or build one.

- When selecting a hosted solution, we will fully consider lock-in and the ease of portability to other Cloud vendors.

- We will consider FaaS for future Cloud expansion and potential cost efficiencies for short lived functions.

- Further investigation and research will be conducted into providers

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Cloud Computing – an alternative provisioning method of on-demand computing resources

Cloud Computing – What is it?

- Cloud computing, often referred to as simply "the Cloud," is the delivery of on-demand computing resources — everything from applications to data centers — over the internet on a pay-for-use basis
- The Cloud is an alternative method to having a local server or a personal computer

Hosting Options

Depending on the requirements for privacy, flexibility, etc. Cloud computing variants can include any of the following:

- Private Cloud – also known as a internal or enterprise Cloud. One of the advantages of a private Cloud is that it's a secure Cloud based environment. However, all server implementation and maintenance is the responsibility of the customer, e.g. ONS's Crown Data centre environments.

- Public Cloud – these are standard Cloud computing model where resources are available to the public over the internet and all management of the data centre is the responsibility of the provider. E.g. ONS currently make use of several of the different public Clouds such as AWS, Google and Azure who maintain the infrastructure.

- Hybrid Cloud – this is a combination of the two above. Either as; using public or private Clouds, from multiple providers, for multiple tasks (*Multi Cloud); or* a mixture of public and private Cloud infrastructures that are connected together and orchestrated to run together for a single task (*Hybrid Cloud)*. This solution offers benefits such as cost management, utilizing third part specialisation, security considerations as well as many other factors which will be discussed in the next few pages.

Everything as a Service (XaaS)

Three of the common Cloud computing services are Software-as-a-Service (SaaS), application Platform as a Service (aPaaS) and Infrastructure as a Service (IaaS).

Vendors are increasingly offering additional services via the Cloud, this has led to the concept of Everything-as-a-Service. Including Container as a Service (CaaS) to delivery product through to Team as a Service (TaaS) which will can free time, resources as well as provide specialist teams for specific projects. This will transform how organisations could operate in future.

- The government introduced a 'Cloud First' policy in 2013

- When procuring new or existing services, public sector organisations should consider and fully evaluate potential cloud solutions first before considering any other option.

- By Cloud First, we mean the public cloud rather than a community, hybrid or private deployment model.

- The Technology Code of Practice is a set of criteria to help government design, build and buy better technology which includes cloud first advice (see slide 49 for more details)

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Cloud Computing - Our future technology infrastructure will be cloud first..

- Technology departments are evolving - they are moving from a one size fits all approach to a fully adaptive and agile way of working
- The diagram below shows how technology departments will evolve from having monoliths and legacy systems to full adoption of Public Cloud

Evolution →

	Enterprise IT era	Cloud IT era	Matrix IT era
Operating Model (OM)	• Hierarchy, functional alignment • Suppliers • Outsourcing • One size fits all (OSFA)	• DST merging with the business • Partnership developing • Hybrid of OSFA and specific OMs	• Business technology • Part of complex ecosystem • Contextual process and structure
Culture	• Inside-out • Command and control, HIPPO • Shadow IT	• Moving from Inside-out to Outside-in • Some autonomy • CoE	• Outside-In • Empowerment, safety • Innovation across the business
Practices	• Waterfall, ITIL, N+1 • Monoliths, COTS, data centres	• DevOps, Agile, Scrum, Lean, DfF • Public / Private Cloud	• The right methods • Public Cloud

Key Principles

- Hybrid Cloud (both private and public) where appropriate. This provides cost efficiencies for services that need to be always-on. Making short term cloud burstable demand available via public cloud.
- Multi Cloud policy to effectively manage vendor lock-in and subsequent risks regarding security, cost, scalability.
- Cloud Native products will be used, such as Software as a Service (SaaS) e.g. Office 365, Service Now. Offering faster time to implement and removing the need for DST to support, maintain and upgrade services.
- Focus on delivering business services and consuming infrastructure, not build, by making use of new technologies, such as Serverless and Functions.

All new technology development within DST will follow 'Cloud first' policies in line with Government Cloud First policy.

- The growth of technical capability within the business has resulted partnerships when developing technical solutions e.g. SPP.
- This will deliver greater customer value creation, which is key to future ONS successes.
- Adoption of Agile practices will reinforce the partnership between DST and the business.
- Pay-on-use cloud services will help to embed a culture of innovation and experimentation to deliver insightful statistics.

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A key benefit of Cloud is cost efficiency...

- Rather than investing in hardware and the associated costs of installation, maintenance, software patching and upgrades we will move to a consumption based model, where all of these costs are borne by the provider

- Consequently we will subscribe to a service and pay for 'only' what we use

- This will help us avoid costly bills for future capacity planning and peak expansions of service

- In addition we will treat workplace consumables (e.g. laptops, monitors etc) as non-depreciating assets, as the lifetime of these components is decreasing. The capitalisation will become closer to two years and therefore should be treated as a resource cost

- This will result in a change in budget allocation in the next spending review period where capital will reduce to 5 – 7% as compared to the existing 10 – 12%

- The benefits of this approach are
  - Overall costs, based on a like for like service are lower
  - There will be more opportunity to shop around for the best product and price
  - Speed to deployment and our ability to respond to change will be greatly increased

Perceived Benefits of Cloud Computing Usage Worldwide 2017

% respondents identified as a benefit

Category	%
IT Staff Efficiency	34%
Cost Savings	35%
Move to Opex	38%
Higher availability	56%
Greater Scalability	61%
Faster access to infrastructure	62%

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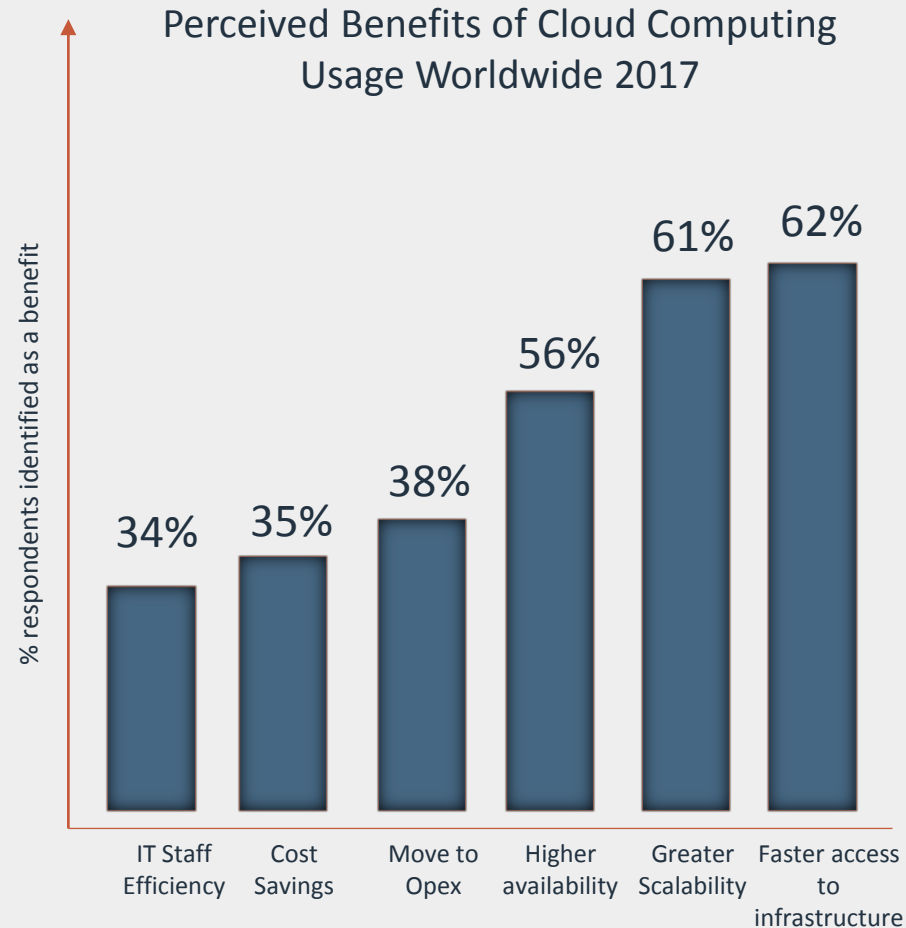
Cloud Computing – The primary reason to move to Cloud may be driven by cost savings but there are many other benefits too

According to research by Rightscale, the primary driver for adopting Cloud is due to operational savings, closely followed by 24/7 service and flexibility of delivery. Whilst these are the primary reasons, it is clear that there are a combination of factors which are driving the move to Cloud

For the Technology Services divisions the main benefits are:
- Removal of the hardware renewal cycle costs, thus minimising business downtime
- Increasing support for remote working
- Cloud has enabled greater use of the right tool for the right job
- Using Cloud computing results in having the latest technology and the latest updates (Evergreen architecture)
- Changes can be tested with minimal time and cost implications
- New employees will be more familiar with Cloud computing rather than on-premise technology
- Provides unlimited storage and which is scalable both up and down

Operational cost savings are a big factor in adopting Cloud....
- Greater cost agility can be achieved where financial outlay can go down as services are no longer required without the need to renegotiate complex commercial contracts
- Increased retained cash realised by moving from a Cap-Ex model to a 'Pay as you go' Op-Ex model
- Reduced opportunity costs – freeing up cash to invest in other parts of the business
- However, the move to Cloud will likely require a significant investment in people and culture in order that the move to Cloud can be fully utilised

Leading reasons for adopting hosted or cloud –based services in UK companies in 2017

Reason	This was a reason	This was the primary reason
Flexibility of delivery	64%	12%
Operational cost savings	61%	14%
Scalability	61%	10%
24/7 service dependence	48%	13%
Low cost of adoption	54%	7%
Policy decision	46%	4%
Limited internal resources	41%	5%

■ This was a reason ■ This was the primary reason
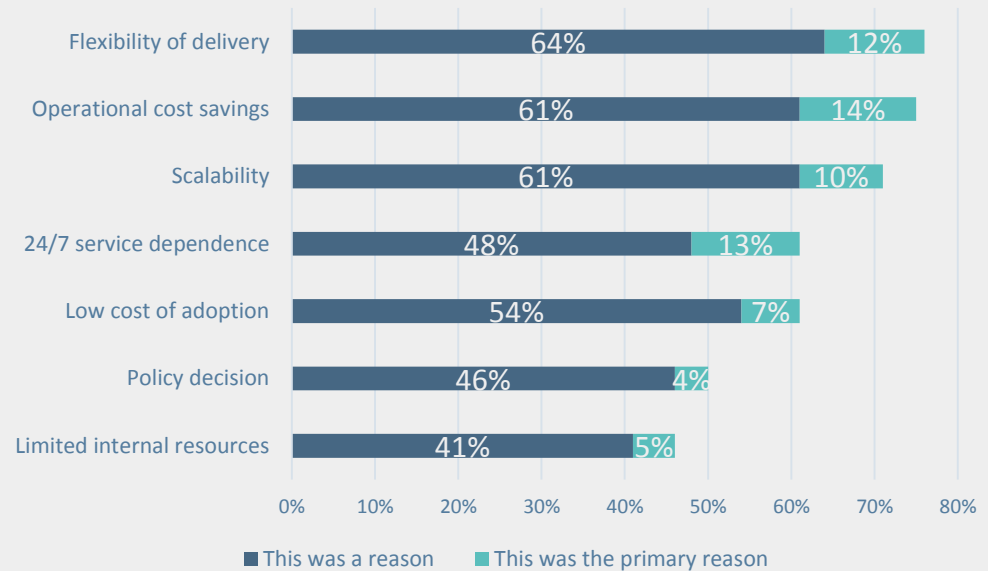
Cloud Computing – Successful migration to Cloud will require considerable investment in our people and culture

Whilst the research suggests clear long term advantages in the move to Cloud, there will be challenges for technology departments and in the wider business in terms of making it work. It is paramount that we employ a clear approach and communications plan for it to succeed
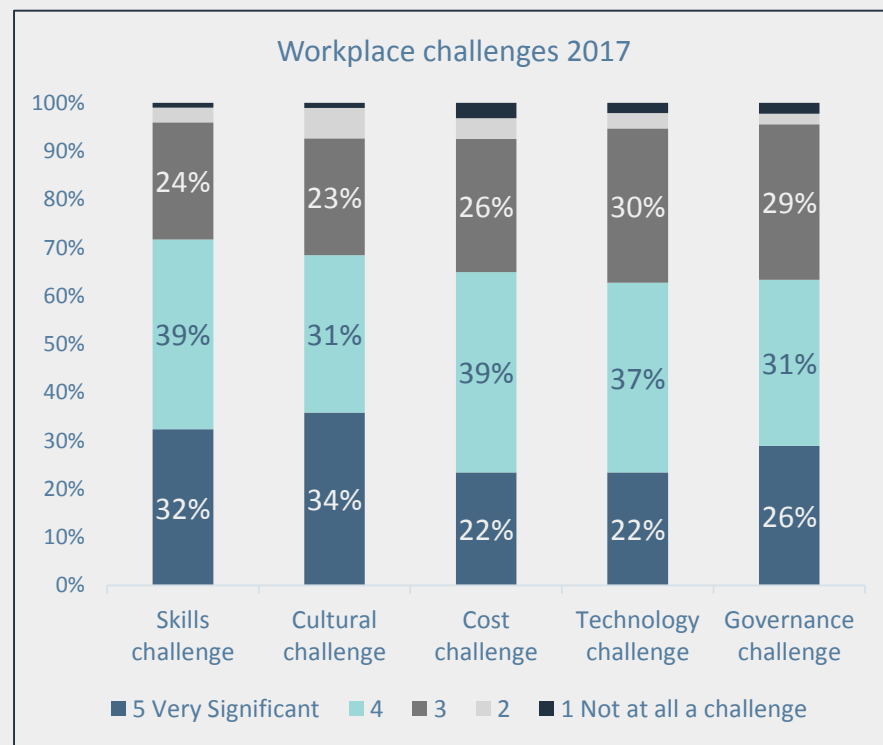
The Challenges for ONS

- Creating self-organising development teams which will includes Operations, Development, QA and business staff which will speed up delivery of new services for customers
- There will need for all developers to develop for Cloud native i.e. concurrency, disposability, etc. (https://12factor.net/)
- A need to grow Cloud expertise including financing, initiating and managing Cloud services
- Ensuring applications can handle Evergreen Architectures i.e. components continually receiving patches and updates. Failure to do so will cause outages for customers.
- Breaking monolith systems into microservices to ensure Cloud compatibility which will drive application adaptability and create a more responsive architecture.
- Ensuring continued adoption of agile across the whole organisation, not water-scrum-fall

Cultural and Organisational Challenges

In order to have a successful Cloud native strategy there are changes to the way an organisation approaches IT services. Cap Gemini reports that Skills (70%) and Culture (65%) are the biggest challenges to deliver a Cloud native strategy.

The Cost Challenge

Whilst there are cost efficiencies, as outlined on the previous page, there will also be initial cost challenges. There will be tangible costs around the infrastructure required, as well as intangible costs such as lost development time, and organisational change.

Workplace challenges 2017

Challenge	5 Very Significant	4	3
Skills challenge	32%	39%	24%
Cultural challenge	34%	31%	23%
Cost challenge	22%	39%	26%
Technology challenge	22%	37%	30%
Governance challenge	26%	31%	29%

Legend: ■ 5 Very Significant ■ 4 ■ 3 ■ 2 ■ 1 Not at all a challenge

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Cloud Computing – The future is maturity and specialisation with better management tools and reducing operational costs

Cloud consolidation and maturity

- Forrester's foresee the consolidation of Cloud rather than an introduction of new Cloud providers. Rather there will be specialisation linked to specific industries and services.
- Thoughtworks speculate that there will be a maturity of the offerings from Cloud vendors, especially AWS. This comes with an expected improvement in Cloud management solutions or offered for free as competition increases. This comes at a time when RightScale measured Cloud waste of 30% to 45%.
- However, there is still some fragility in terms of how vendors will handle future legislation.
- Zero Trust security will become even more tightly integrated as Cybersecurity and data protection still remain the top strategic challenges of Cloud-native leaders.

73%	27%	75%
By 2021, 73% of Cloud workloads and compute instances will be in public Cloud data centers, up from 58 percent in 2016	By 2021, 27% of Cloud workloads and compute instances will be in private Cloud data centers, down from 42 percent in 2016	total Cloud workloads and compute instances will be Software-as-a- Service (SaaS), up from 71 percent in 2016

Cisco Global Cloud Index: Forecast and Methodology, 2016–2021 White Paper

Key Points

- Avoid Cloud vendor lock in by making use of multi Cloud provision, this will become more important as vendors become more specialist. This comes with its own challenges.
- Evergreen Architecture represents an opportunity to automate infrastructure, networking, servers, services and interconnections. This portability will allow greater freedom to move environments and avoid vendor lock (see following slide).

Spend

- The New York Times predicts Serverless (or FaaS) computing to become the next step in Cloud evolution. Reducing costs and increasing efficiency as its based on event driven demand.
- This could have an overall reduction on ONS spend which stands at circa £800k/pa using AWS and Azure.
- Gartner predicts that SaaS spend will continue to be the key Cloud service sector to grow. This is reflected in ONS's planned move to O365 full Cloud and related services.
- Public sector analysis suggests Analytics/Big Data and Cloud Computing will continue to be the most important trends prioritised over the next three years.

- Cloud first offers opportunities to increase speed of delivery to the business, exploiting third party products to enhance our own products and increase collaboration between organisations.

- Moving to Cloud first computing requires greater financial rigour in order to effectively manage the change from CapEx to OpEx model.

- ONS will see more specialist Cloud providers offering more tailored products which will reduce the complexity and barriers to entry

- ONS must consider multi Cloud provision to avoid vendor lock in

- Serverless and Function as a Service computing will offer opportunities to reduce financial costs of Cloud.

- ONS currently has training plans for technical staff, these will become more focused on Cloud deliverables.

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Cloud Computing – Will support and enable the evolution to Evergreen

Evergreen – What is it?

- Evergreen refers to running services that are always up to date. Typically by subscribing to a Cloud based service such as Office 365
- A pattern of IT provisioning architecture and operational management designed to deliver loose coupling between logically distinct business services
- The goal is to transition IT operations from predominantly manual to predominantly automated processes driven by intelligent software

Evergreen – The future?

- As IT landscapes become increasingly complex and harder to manage, big bang and ad-hoc hardware refreshes are no longer feasible
- Evergreen IT will become the norm and organisations will maintain their on and off premise infrastructure and applications
- IT departments will utilise Evergreen to stay competitive, prevent data breaches and remain flexible to react to changes in their business requirements

Using automation, orchestration, and modeling technologies

Using Virtualisation

Changing the way in which the IT organisation meets user needs

Adapt to a modern service management model

Evergreen – The benefits

- With Evergreen IT, the idea is to have agile software solutions that are not only always up to date but also change as the needs of the organisation change – This will ensure increased flexibility
- Incremental IT investment will no longer create legacy systems
- The roll out process for updates will be much shorter but will be more frequent
- It makes all software, file storage and hardware management an ongoing, iterative and self improving process

- ONS runs a traditional desktop service where a complex build is undertaken for a specific device and software is distributed by way of help desk calls. It has a high recourse overhead and is complex to maintain

- Moving to an evergreen service requires a change to the technology and management approaches

- Many processes (e.g. procurement) that will need to be redesigned to support more frequent needs for managing IT landscape on a continual basis

- It will also require a cultural shift – there will likely be apprehension around the idea of continual updates and possible loss of control

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Cloud Services – enables greater focus on business benefit, less on infrastructure management

Evolution of Cloud

Cloud services have evolved from Infrastructure as a Service (IaaS) to Platforms as a Service (PaaS), Containers as a Service (CaaS), finally to Function as a Service (FaaS). FaaS allows software developers to concentrate on developing code to meet business functionality and users needs, and not on implementing, maintaining, debugging or monitoring infrastructure.

Launched in 2014, AWS Lambda is one of the most popular and recognised FaaS services. In 2016, Microsoft launched Azure Functions and Google launched Cloud Functions.

Decreasing concern on infrastructure implementation
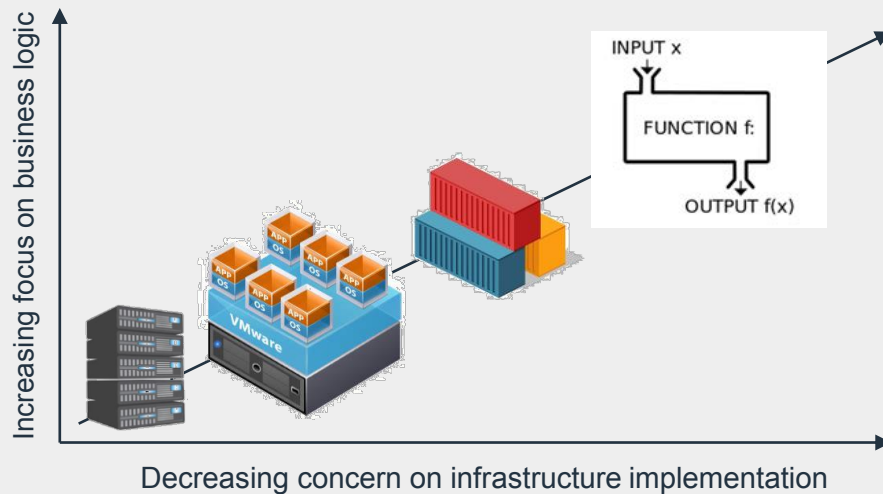
However, FaaS is not always appropriate for every scenario. Containers and serverless both have advantages and disadvantages too deliver virtual infrastructure abstraction and increase focus on business benefit.

Containers

Containers are single instances which are deployed with all it's dependencies pre-installed with the application code. Therefore, every instance runs with no differences between them.

This provides advantages including, becoming highly portable between public and private clouds. This supports a **key requirement of the Census delivery team which is** becoming cloud vendor agnostic.

Containers provide the flexibility to run a specific software versions and operating systems. This is particularly useful when breaking up a legacy solutions into logical functions due to environmental constraints.

However, containers still require a lot of maintenance and set-up. Engineers have to look after the container configuration, ensuring patches and security fixes are up to date. Scaling up and down instances to handle demand isn't as fast as serverless whilst there will always be a runtime cost associated with running containers.

Serverless Architecture – Key Features
- Serverless architecture is also known as serverless computing or function as a service (FaaS)
- There is no need to buy, rent or provision servers or virtual machines
- Serverless is a way of building and running applications and services without the infrastructure management overhead
- It doesn't mean servers aren't used, just that cloud providers run the servers, and dynamically manage allocation of machine resources.
- Pricing is based on the actual amount of resources consumed by an application, rather than on pre-purchased units of capacity

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Containers and Serverless both have roles to enable better optimisation of cloud services.

Serverless Architecture – How does it work?
The basic premise of FaaS is that you upload your code as a Lambda function (for AWS) . Common languages across the different vendors include Node.js and Python, other specific to vendors are available e.g. MS - .NET, Google & AWS - Go.

Key properties of functions are, that they are:
- Independent, logical functions
- Ephemeral (may only last for one iteration)
- Stateless (no information is retained once complete)
- Event-triggered
- Scalable by default (can scale up and down)
- Fully managed by a Cloud vendor (a third party)
- Secure NCSC comment

Each function is encrypted at rest and runs in its own isolated environment, with its own resources and own file system view. Feedback from the National Cyber Security Centre (NCSC) have recommended this is currently the best way in which to run cloud applications.

AWS Step Functions can be used to chain together many functions to design a serverless business process workflow. The use of step functions is being used at ONS for it's legacy uplift program. A simplified example of this can be seen in the diagram top right.

Disadvantages of FaaS
Currently there is no way to make serverless cloud vendor agnostic with little in the way of standardisation. There is no current way of creating development environments locally, therefore greater effort is required providing Continuous Integration and Continuous delivery.

ONS Statistical Pattern
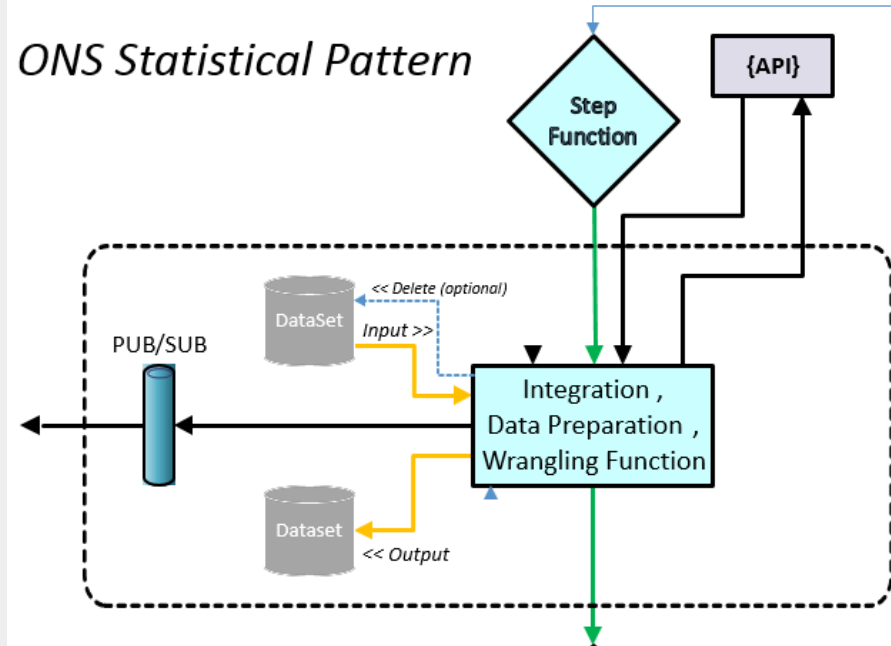
- DST are already experienced with Containers as a Service (CaaS) and are successfully using them to migrate the existing survey tools into a cloud agnostic solution for Census.

- DST has already proven the benefit that can be derived from FaaS in the ONS, as seen in the Legacy Uplift programme. Taking advantage of the cost flexibility of FaaS.

- Both FaaS and Serverless give ONS the benefit of increased focus on delivering business benefit and reduced concern and overhead of managing infrastructure environments.

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We don't have definitive answers about the future, but there are clear signs that the workforce of tomorrow will be different to that of today..

Key trends

Demographic changes
- Over the next 25 years, the number of people aged 65 years and over is expected to rise by nearly 60%, making up almost a ¼ of the population
- The continuing pensions crisis will mean an increasing number of people working beyond 65, with a norm for retirement at 75
- Tech Savy Milleniums (Gen Y) and Gen Z will also be part of the workforce along with Gen X and the Baby Boomers
- This will result in a multi generational workforce, spanning 4 different types of generation all with varying needs and wants
- With Gen Y being much more mobile and more likely to change jobs, talent retention will become much more competitive

Growing desire for better work life balance
- Whereas 20 years ago salary and status may have come top of the list, there is now more emphasis on family-friendly policies and good corporate responsibility

Technology Advances
- An even greater proliferation of mobile devices will force workers and employers to draw greater boundaries between on and off duty time
- It is predicted that there will be a rise in 'virtual jobs' – roles in virtual environments where work activities and transactions have no physical representation
- Further advancements in the fields of robotics, algorithms and artificial intelligence (AI) may make it possible to automate processes and services
- AI is increasingly used to facilitate capturing, structuring and analysing big data
- As smart machines take over some routine jobs, there is increasing demand for the skills that are (as yet) irreplaceable by machines such as creative and critical thinking

The Workplace
- Relocation of staff to satellite offices with mini business centres cropping up
- Increasingly people will work from home and will only come into the office to collaborate
- In the future workspaces will be made up of mostly meeting space with just a few desks. The concept of having your own desk will no longer exist and hot desking will become the norm


- DST, and the wider ONS are well equipped to respond to these trends
- We have a clear approach to the way we work in DST, which is in line with the wider Government smart working programme (TW3)
- We will continue to adapt our working practices to encourage more flexible working and home working where required
- Our recent introduction to video conferencing and Skype has already improved cross site and home working

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There is a significant gender imbalance in IT roles in the industry and this trend is likely to continue unless employers address the imbalance...
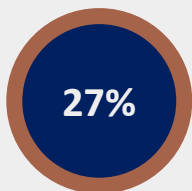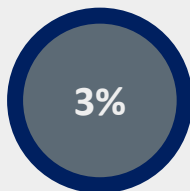
Industry

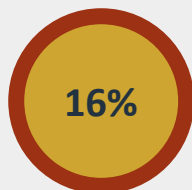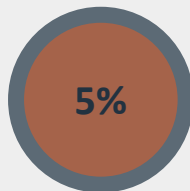**% of females who don't consider IT career as they don't know what it involves** → **69%**
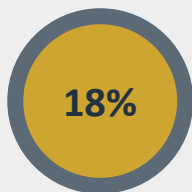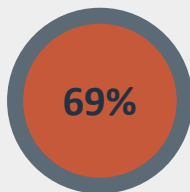
18% ← **% of 14 – 17 year old girls who would consider a career in IT**

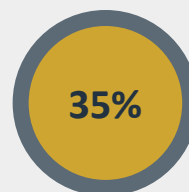**% of females who say a career in IT would be their first choice** → **3%**

27% ← **% of female students who would consider a career in IT, compared to 61% of males**

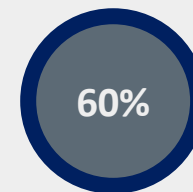**% of leadership positions in the technology sector held by women** → **5%**

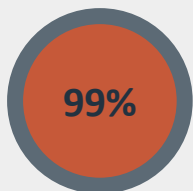**16%** ← **% of females who have had a career in technology suggested to them compared to 33% for males**

DST

35% ← **% females currently working in DST**

% of SCS positions in DST that are held by females → **60%**
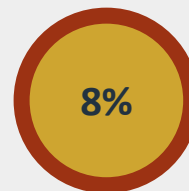
8% ← **% of part time workers with DST**

% staff within DST on flexi-hours (exc. SCS level) → **99%**

- DST have a higher proportion of women in SCS positions
- However, females are currently predominantly in delivery or support roles rather than in technical roles such as software engineers or architects
- We currently receive much less interest from females when technical roles are advertised

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Attracting and retaining skilled IT staff will be a key challenge in the future…

Top 10 Most Popular Careers in the UK - 2018

> **In 2018, 3 of the 10 most popular careers were in IT roles**

1. **Data Communications Analysts:** As more and more organisations now stay in touch internally and externally with other sites via networked communications, analysts responsible for overseeing the installation and maintenance of networks, are a critical resource
2. **Marketing Officer**
3. **Software Engineers:** The IT job sector grows in size as technological advances continue to be made. Software engineers, who design and develop new applications to meet specific needs, are in ever greater demand.
4. **Medical Administrator**
5. **Community Nurse**
6. **Advertising Executive**
7. **Customer Services Assistant**
8. **Information Officer:** Digital technology has enabled organisations to store more data more efficiently than in the past. Consequently, more personnel are needed who can offer specialist skills in operating database software and information networks
9. **Administrator**
10. **Engineer**

Research by Tech Nation highlighted that those who want to work in Technology cited the 'fast moving and exciting nature of the tech sector' (55%), the 'interesting jobs' it offers (54%), 'good pay' (50%), and interest stimulated by 'large tech companies such as Apple, Facebook and Google' (45%) as reasons for wanting to work in the industry.

However, for those not considering a career in IT, this was largely due to a lack of understanding in terms of what a job in technology would involve. Research by KPMG revealed that when asked what a career in IT would be like, youngsters home in on the stereotype that it means to be isolated, sedentary and operating alone in front of a screen for 40 hours a week.

This is not surprising given the vanilla-flavoured IT curriculum at schools which focuses on using word and creating charts in excel. There is broad recognition in the industry that employers need to take a more active role in showing youngsters what a career in IT could involve rather than leaving it to the education system

Top reasons young people want to work in tech

interesting 54%
55% exciting
good pay 50%

- We are seeing some employers take action and setting up groups and ways of targeting more diversity in STEM areas
- DST is a great place to work and we would like to start promoting this more to encourage a more diversified future pool of talent

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Agile software development has transformed how organisations approach delivery, empowering delivery teams and putting the customer first.
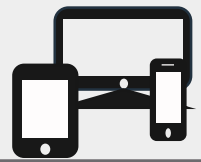
Key Facts
The Agile Manifesto was signed in 2001 and defined a set of principles:

- Agile puts the customer firmly in the centre by establishing and prioritising the user needs via a product owner.
- An incremental approach is taken where value is delivered early and often.
- Empowered and multi-functional DevOps teams ensure that delivered capabilities meet requirements.
- The emphasis is on delivering those items that add real value to the customer and not what the IT department deem most important.
- Constant feedback is provided by daily catch-up's. There are regular demonstrations (show and tells) of new features in order to gain customer.
- Planning is vital, but plans will change based on priorities and team velocity via burndown charts.

A refocus of Agile principles is needed

- Dave Thomas, one of the thirteen who signed the Agile Manifesto, suggests that there is a need to get back to basics with the agile principles.
- There is a natural progression of how good ideas go wrong when the imitators take over and often tarnish it.
- Research suggests, we are in danger of being taken over by imitators and the idiots of agile. He says that agile needs to continue to innovate, balance idealism and practicality, reinvigorate our agile value roots, and unify rather than splinter.
- Estimates range from 12% to 23% of Agile projects are failing completely and companies are set to waste an estimated £37 billion on failed Agile IT projects (May 2017, 6Point6). Possible solutions to this are to keep projects local, scale agile, better documentation, more up front planning and architecture.
- Technical debt of over $1m exists due to poor quality code, this is the result of the 'just good enough' standard.

The top advantages cited by respondents to the state of agile report 2018

Advantages
- Ability to manage changing priorities
- Project visibility
- Business/IT alignment
- Products delivered to market quicker, releasing early and regularly, and customers get a return on their investment sooner.
- Increased team productivity

VS

Disadvantages
- Organisational culture at odds with agile values
- General organisational resistance to change
- Inadequate management support and sponsorship
- Lack of skills/experience with agile methods
- Insufficient training and education

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Agile – the future will be about more frequent delivery of business value from tight & self-organizing teams...
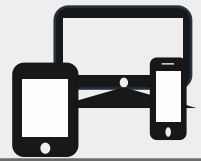
What's Next for Agile?

Thoughtworks consultancy cite four possible ways for the future of Agile, "continue to innovate, balance idealism and practicality, reinvigorate our agile value roots, and unify rather than splinter"

There are those, such as Dave Thomas and many of the agile manifesto originators that conclude a reboot of Agile is required, and a new term should be used in order to reassert the fundamental principles - "an agile philosophy which focuses on culture over methodologies"

Many of the agile manifesto originators agree that there is a need to get back to the fundamental principles of Agile. That future of development will be about more frequent delivery of business value from tight & self-organizing teams, to deliver high-quality products more frequent. This is supported by IBM who suggest there should be a greater importance of the Scrum master and presumably the Scrum methodology.

Reporting and Improvement on code quality

There is a growth in better integrated toolsets in order to assist in the 'requirements to release' lifecycle which will provide greater visibility to teams quality deliverables. Big data analytics could provide greater insight and improvements to agile delivery processes.

IBM stress that the 'just good enough' approach agile coding has resulted in poor quality code and stress the importance of improving the code quality.

Alternative Approaches?

Of the alternative methodologies, most have been around for a while and have branded themselves as alternatives or improvements to Agile.

- Flow is cited as an alternative approach to agile, which is a combination of agile, lean and DevOps. Although it appears to have limited hype, it does make some interesting points regarding reemphasis of Agile philosophy.
- Feature-Driven Development (FDD) invented by Jeff De Luca which is applicable for small teams was designed from the ground up to work for a larger team.
- VerisonOne, an agile software company, state that of companies surveyed 29% of them use Scaled Agile Frameworks (SAFe)
- Research suggests focus on maturing teams and "pod structures— self-organizing, autonomous teams who are equipped with all of the talent and skills required to deliver a product". This supported by Others who cites that self organising teams was exactly what Agile 1.0 was all about. He references the Valve employee handbook a successful gaming company and how it self organises.

- DST should review their use of Agile to ensure alignment with the fundamental principles
- Tooling could assist with improving team deliverables and providing greater insight to cross project milestones
- DST should ensure code standards are of a minimum standard
- Investigate the use of SAFe

Data growth continues to increase with the use of unstructured data and streamed sources

Current Issues

- We are storing more and more data. Internet-connected devices that are constantly collecting and transmitting data, also known as the Internet of Things (IoT).
- As well as traditional datasets, data being used is changing, large data packets such as images and videos as well as smaller sensor and log type data are both being used to create local level statistics and to deliver richer statistics.
- GDPR/Sovereignty Issues

Aggregation of digital unstructured and machine IoT data

- Using and incorporating Internet of Things (IoT) data is a future endeavour for most organisations
- IoT is generating massive volumes of structured and unstructured data and an increasing share of this data is being deployed on Cloud services
- While innovations in storage and managed services have sped up the capture process, accessing and understanding the data itself still pose a significant last-mile challenge
- Big data aggregation goals will expand to visions where standard digital data originally entered by humans and data issued from machines will be aggregated into composite visualisations that will transform the way work is done

Immediately gratifying analytics

- People want data quickly, they don't want to wait for batch analytics reports, which the majority of big data analytics still is
- The pressure on IT is to deliver actionable analytics results faster, and to focus more big data and analytics activities on real-time or near real-time data

The Future of data storage

- Growth of Helium hard drives, which allows disks to spin faster using less power. Currently still expensive.

- DNA storage, in 2012, Harvard successfully trialled the technology. It offers incredible storage density, meaning a DNA hard drive the size of a teaspoon could fit the worlds data on it. Ideal for long term storage as it doesn't degrade, it's very slow to read and write to it.

- Scientists are researching quantum storage where data is attached to a spin of an electron. Making use of *quantum entanglement would result in data being instantly replicated anywhere in the universe, which may cause some security concerns.

- Improved data quality and service to business to enable better sampling and greater business value - To expose the indexes to wider government departments

- ONS will only see more use of IoT data to deliver richer statistics
- Incorporating traditional data and IoT data will be a challenge
- There will be a move from traditional batch type processing to more streaming real-time or near real-time analysis

* Quantum entanglement is where particles have interacted in the past and then moved apart. Any change to one particle is in theory replicated in the other.

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How we store and process the data we have access to

The Big Data Revolution

The Big Data revolution has brought about a transformation of how data is captured, reviewed, aggregated, transformed and held. ONS wants to process new and diverse data sources more quickly and effectively than ever before helping reduce respondent burden.

ONS along with all data organisations is moving from architectures that store data in silos to architectures that combine data in a lake. The establishment of the Digital Economy Act (2017) will allow greater data sharing between government departments.

Big Data Challenges

The growth in available data brings challenges in how to store and process data. ONS has implemented Cloudera's data lake capability and related tools in order to link, interrogate and manipulate data. Future challenges include how to collaborate with other data suppliers.

Data Collaboration

In order to collaborate more, ONS needs to establish robust data sharing mechanisms. We will need to assure our partners that we have adequate data management controls in place to handle data privacy and sovereignty concerns.

How do we share data with partners

There are several technologies ONS will investigate in order to share data with our partners

- Data Virtualisation is the concept of a virtual database which sits in front of multiple data sources and allows them to be treated as single source. Data Virtualisation could potentially link many different data lakes. This technology is currently in early investigation. Redhat's Data Grid is one example

- API Gateways are the current technology used by most Cloud providers to share data. ONS are already using this technology in the Registers projects and other areas of the business

- Co-operative infrastructure with major data partners is another solution. Putting a "Black box" into a data supplier can give us access to the required information.

- Secure multi-party computation is a way "for parties to jointly compute a function over their inputs, whilst keeping those inputs private". This could provide one way for ONS to process secure encrypted data. This research is still in an early stage and significantly increases the time taken to process data

- Differential privacy is a cryptographic method which aims to provide means to maximise the accuracy of queries from statistical databases while minimizing the chances of identifying its records

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The Technology Code of Practice

1. **Define user needs –** Understand your users and their needs. Develop knowledge of your users and what that means for your technology project or programme

2. **Make things accessible –** Make sure your technology, infrastructure and systems are accessible for users

3. **Be open and use open source –** Publish your code and use open source to improve transparency, flexibility and accountability

4. **Make use of open standards –** Build technology that uses open standards to ensure your technology works and communicates with other technology, and can be easily be upgraded and expanded

5. **Use Cloud first –** Use public Cloud first as stated in the governments Cloud first policy

6. **Make things secure –** Keep systems and data safe with the appropriate level of security

7. **Make privacy integral –** Make sure citizens rights are protected by integrating privacy as an essential part of your system

8. **Share and reuse technology –** promote good practice and avoid duplication efforts by sharing and reusing services, data and software components

9. **Integrate and adapt technology –** Your technology should work with existing technologies, processes and infrastructure in your organisation, and adapt to future demands

10. **Make better use of data –** Consider how to minimise data collection and reuse data to avoid duplication of datasets

11. **Define your purchasing strategy –** Your purchasing strategy must show you've considered commercial and technology aspects, and contractual limitations

12. **Meet the Digital Service Standard for digital services –** If you are building a service as part of your technology project or programme you will also need to meet the Digital Service Standard

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Publication details

This document has been produced collaboratively with the DST leadership team as follows:

Sponsor: Simon Sandford-Taylor

Business Manager: Jan Jones

Key Contributors: Ceinwen Blake

                          Marc Craddock

                          Jim Evans

                          Sam Hall

                          Stacey Hawkes

                          Ruairidh McLeod-Lyon

                          Sonia Unsted

Authors: Helen Sandford

                          Jan Murdoch

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