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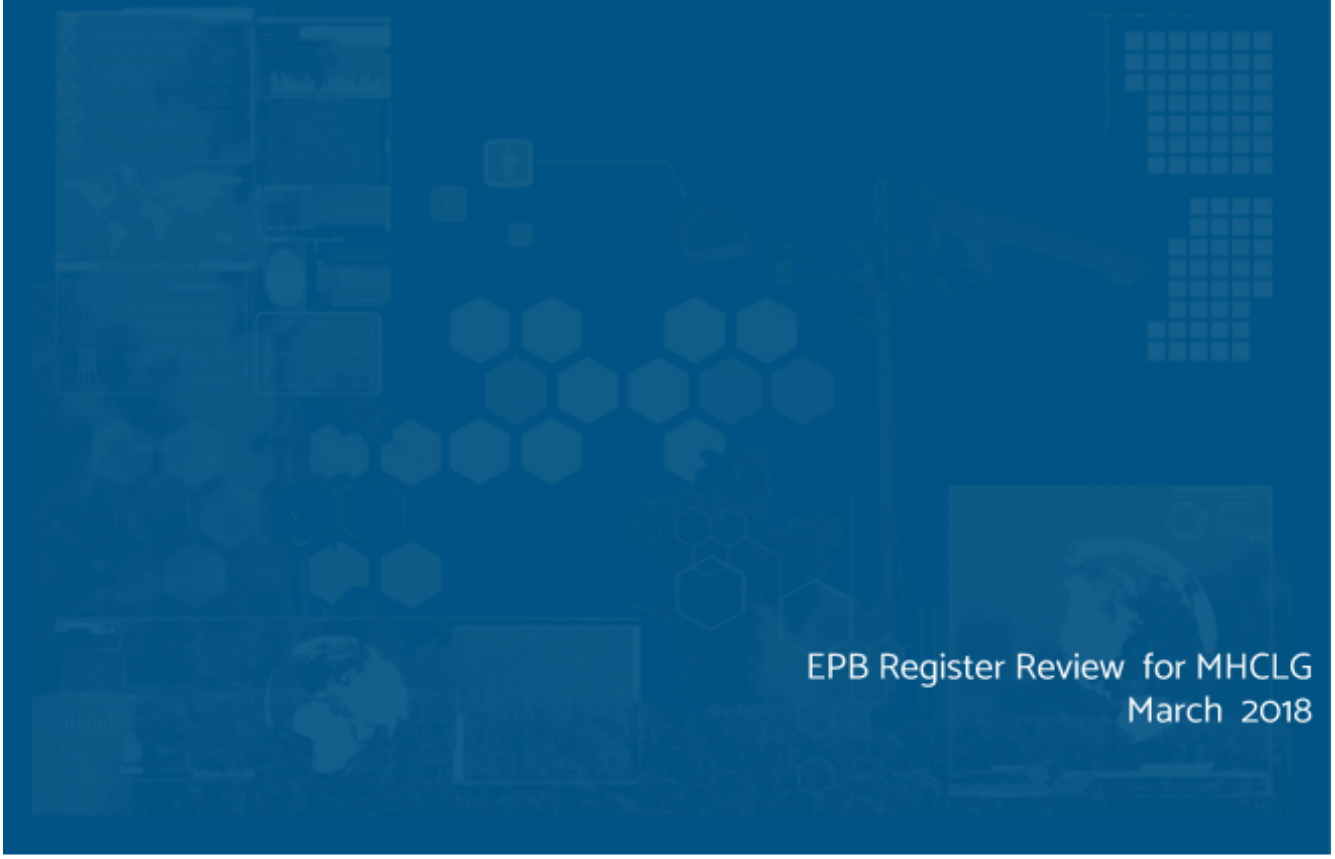
Secure Cloud Services and Solutions



EPB Register Review for MHCLG

March 2018

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0.1	March 18	VCL-MHCLG--EPBR-Service-Review	First Draft - populated from agreed Template/Outline
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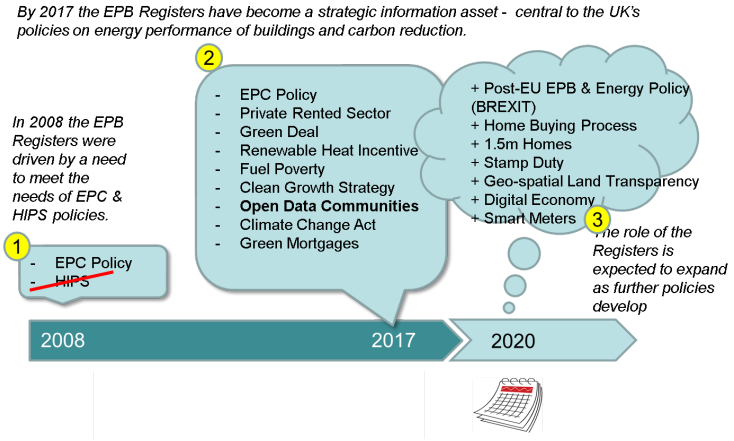
Contents

1. Introduction & Scope

The Energy Performance of Buildings Registers (EPB Registers) play an important role in supporting UK energy efficiency policies. They provide a central repository of data which supports efforts to make buildings more energy efficient, which in turn enable efforts to constrain energy demand from buildings and help meet the UK's carbon reduction targets. The EPC energy efficiency rating system has evolved from its original purpose – to inform home buying/rental decisions, and has become an important component for energy performance and carbon reduction policies.

Since 2007 use of the EPC rating system has evolved from its original purpose – to inform home buying/rental decisions, and has become a de facto standard reference for energy performance of buildings policies.



In considering business options for the EPB Registers, it is apparent that use of EPCs as a delivery vehicle for government policy is likely to evolve further in the near future.

The EPB Registers are currently delivered via concession contracts placed with the Landmark Information Group since 2007. These contracts are due to expire in December 2018 prompting re-evaluation of business needs. Both contracts can be extended to the end of December 2019, but no further.

Following a review of business needs, the Ministry of Housing, Communities & Local Government (MHCLG) intends to re-procure the EPBR services on a similar basis to the current arrangement with Landmark. MHCLG acknowledges that the legacy solution (which it owns) could play a useful role in the transitional arrangements.

In preparation for re-procurement of the service, MHCLG commissioned an independent service assessment engaging Viewdeck Consulting Ltd to undertake this assessment.

The purpose of this assessment phase is to understand the residual life of the legacy solution, and inform service level requirements for a future EPBR service; specifically:

- document the legacy EPBR solution components, with a focus on collating and reviewing existing documentation
- assess the technical obsolescence and potential residual lifespan of EPBR solution components
- determine whether EPBR service levels have introduced avoidable costs (or have been unnecessarily excessive), and assess the potential to make future cost savings by adjusting service levels
- determine whether the EPBR solution life could be extended beyond the 2 years currently assumed. If so, how might this be achieved and what risks would it raise?

- determine whether the EPBR solution could be transitioned (in situ) to 3rd party management and identify any issues arising
- consider how a future EPBR solution could be designed to flex according changing policy needs and market activity (e.g. through use of cloud-based services).

There are two outputs from this review:

1. A written report (this document).
2. A presentation of the report, at management summary level, to the EPBR Project Board.

2. Management Summary

The Management Summary is included in a separate slide presentation pack.

3. Inputs & Contributions

Viewdeck would like to thank the Authority and Landmark Information Group (LIG) for their inputs and contributions to this report.

A substantial volume of documentation, as referenced in Appendix A, was made available to our review team. This documentation encompasses service specifications, interface specifications, technical documentation, data models, service reports, service management process models and other relevant inputs.

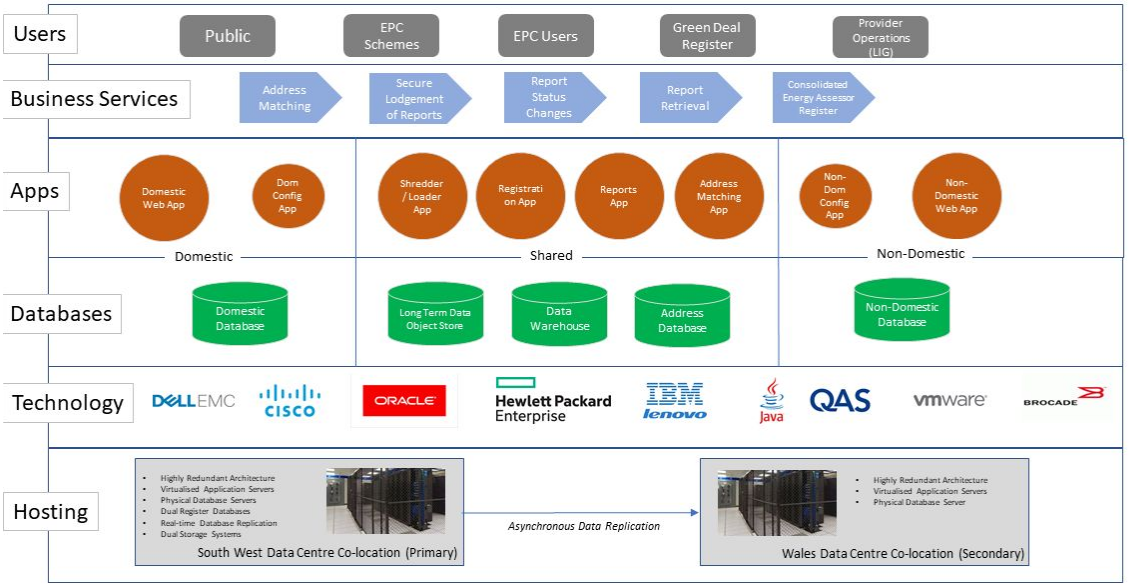
Stakeholder consulted during the review are as follows:

Name	Role	Date	Scope
Debbie Brown	Authority Project and Contract Manager	Duration	Review requirements and assurance
Colin Hookham	Authority Senior Business Analyst	Duration	Review requirements, Authority directives and assurance
Jason Ward	Authority Policy Advisor	Duration	Authority policy directives and assurance.
Joe Glancy	LIG Account Director	Duration	Service and industry information
Richard Forbes	LIG Head of Service Delivery	08/03/18	Service information
Greg Gould	LIG Project Manager	08/03/18	Service information
Anthony Allen	LIG Development Manager	08/03/18	Service information
Jim Bowery	LIG DBA Manager	08/03/18	Service information
James Harris-Deans	LIG Infrastructure Manager	08/03/18	Service information

4. System Specification Summary

This section provides an overview of the EPBR system architecture describing the key components of the system, the relationships between them together with key features and non-functional characteristics. It sets context and understanding for addressing short, medium and long term options.

A single page conceptual view of the EPBR solution is shown in the following diagram. This view of EPBR is a synthesis of system related information gathered from MHCLG and Landmark during discovery activities.



4.1. Users

Users of the Register services are categorised as follows:

- General Public unauthenticated online access.
- Authenticated online access by registered users, such as the EPC Accreditation Schemes.
- Authenticated programmatic access to Web Services, e.g. using validated EPC software.
- Authenticated access by the Authorities users, e.g. to produce reports.
- Authenticated access by Landmark for service operational and administrastration purposes.

4.2. Business Services

The core business services provided are as follows:

- Address Matching - ensuring consistent address data is used across the industry.
- Secure Lodgement of Reports - verification and storage, for a period of at least 20 years, of reports lodged by Accreditation Schemes.
- Report Status Changes - enables the Accreditation Schemes to change the status of their lodged reports.
- Report Retrieval Services - retrieval by authenticated users (in XML or PDF) and unauthenticated users (PDF only).
- Energy Assessor Register - maintenance of a register, by Accreditation Schemes, of their Energy Assessors.

4.3. Applications

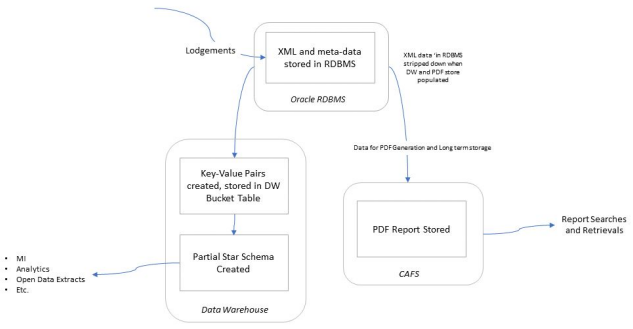
The above user needs and business services are enabled through a set of applications, some aligned to specific Registers and some shared:

- Domestic Register Application - provides the user online and programmatic interfaces, and business process logic supporting the Domestic Register.
- Complexity in the code-base arises due to variations in the register types and regulatory sets that need to be managed, i.e. Domestic/Non-Domestic, England/Wales and NI.
- Domestic Register 'configuration' applications - used by the service provider (Landmark) for system management and operation purposes.
- Non-Domestic Register Application - provides the user online and programmatic interfaces, and business process logic supporting the Non-Domestic Register.
- Non-Domestic Register 'configuration' applications - used by the service provider (Landmark) for system management and operation purposes.
- A common Loader/Shredder application service is used to process the complex XML data structures lodged for both Domestic and Non-Domestic schemes.
- Registration of Domestic and Non-Domestic users for authenticated access is supported by common application services.
- Address Matching is provided through a shared 3rd party addressing service, incorporating the database (see below) as a 'black box' component..
- Management Reporting and Analytics is provided through a common Reporting Application service.

4.4. Databases

The data managed through the above application is supported by a number of databases, some Register specific and some shared:

- Domestic Register Database - holds the XML and meta-data for lodged Domestic reports, together with Scheme management data.
- Non-Domestic Register Database - holds the XML and meta-data for lodged Non-Domestic reports, together with Scheme Management data.
- Data Warehouse Database - populated via the Register databases, it holds Schemed and Lodged Report data in formats suitable for use in providing Management Information, Analytics, Open Data Extracts and other information centric services.
- Long Term Data Object Store - populated via the Register databases, it provides long term storage of data required to generate Reports.
- Address Database - this is the 3rd party database that holds data used for address matching and verification, effectively a 'black box' component.
- The flow of lodgement data through the system is illustrated in the following diagram:



1. Lodgements are initially stored, in XML format together with related meta-data, in a Register database.
2. Follow up processing uses the stored Register data to:
    - Create additional records in the Data Warehouse, in a schema format suitable for analytical and MI queries.
    - Populate the Long Term Data Store, in a format suitable for report searches, retrievals and PDF generation.
3. On successful population of the Data Warehouse and Long Term Data Store only a subset of lodgement data in the Register database is required, so data is stripped from that record.

The relationships between the three data-sets across three different technical platforms creates some complexities that need to be fully understood and carefully managed through a data migration process. This is referenced again in the Transition section of the report.

4.5. Technology

The Register services are implemented on a wide range of 'high-end', commercial software and hardware technology together with use of some Open Source software. The core technology set is as follows:

- **Domestic and Non-Domestic Register Applications** - are developed mainly using standard open technology, e.g. Java, HTML, Javascript and SOAP Web Services. The application components are deployed within Open Source (Apache) HTTP and application servers. There is a significant use of proprietary Stored Procedures within the Oracle Database.
- **Domestic and Non-Domestic Configuration Applications** - the Oracle Application Express (APEX) application platform is used extensively for this purpose, together with some additional proprietary tools and scripts developed by Landmark..
- **Domestic, Non-Domestic, Data Warehouse and Address databases** - all are implemented on Oracle Database relational database management system. Oracle Data Guard is used to help ensure that availability, data protection and disaster recovery service levels are met.
- **Storage** - These databases, together with other system data (except for the Long Term Data Object Store - see below), are stored on a Dell EMC VNX Storage system, using Brocade fibre connections.
- **The Long Term Data Object Store** is implemented using the Dell EMC Centera platform, content addressable data archiving.
- **Virtualisation** - the Register applications are virtualised for deployment using VMWare ESX technology, deployed across a range of standard Intel based Linux servers mainly from IBM plus some from EMC Dell and HP Enterprise.
- **Servers** - the Oracle databases are deployed onto designated physical servers, again Linux servers from IBM.
- **Address matching and verification software** is obtained from Experian QAS.
- **Network** - the dedicated system network within the Data Centres is implemented using Cisco switches.
- **Firewalls -** from Cisco and Fortigate provide security layers.

4.6. Hosting

Key features of the Data Centre Hosting platform for the Registers are as follows:

- Hosting is provided via two geographically separated Data Centre Colocation facilities, the primarily location in the South West with the secondary location (for backup and disaster recovery) in South Wales.
- The MHCLG estate in each Data Centre is physically separated from other services, sharing only power, lighting and cooling systems, and 'caged' for physical security..
- The infrastructure is implemented in a highly resilient configuration, with no single points of failure, in order to meet availability and data protection requirements.
- The primary Data Centre hosts two separate Oracle database instances with real-time replication between the instances..

- Data is then replicated synchronously from the primary to secondary Data Centre.
- The secondary Data Centre is 'scaled down' from the primary in terms of infrastructure provisioning, sized to provide a reduced but adequate level of service in a failover/DR scenario.
- The inter-Data Centre network connectivity is shared with other Landmark services and not regarded as a transferable asset - see also the Transition section below.

4.7. Service Management

Management of the Registry services is the responsibility of the supplier, i.e. Landmark, who utilise the following capabilities:

- Monitoring of the system network and other components is achieved using the Paessler PRTG Network Monitor tool.
- The Service Desk uses ZenDesk software for incident, request and related service management functions.
- Other tools and bespoke software are used by Landmark for some aspects of service management, including Security Certificate Management and Password management.
- *Note that the service support and management tools used by Landmark (a full list is included later in this report) are considered, by them, as part of their cross-client general support platform hence viewed as outside of the scope of transferable assets.*
- The Landmark Development team provide 1st line support support during normal working hours, the Infrastructure team provide out of hours support with the Development team on call-out if required.
- Commercial third-party software support is provided mainly via the end-suppliers, e.g. Oracle, VMWare together with some partner organisations, e.g. itelligence for SAP (Business Objects).
- The majority of hardware support is contracted through 3rd party organisations primarily 101 Data Solutions and Softcat, with a lesser amount directly with the end supplier, e.g. EMC for storage systems..
- A subset of 'ITIL like' process flows, e.g. for Change Management and Asset Management, have been seen, though not the comprehensive suite of processes required to run an enterprise level service.
- The Asset Register needed to be brought up to date and enhanced with additional information in order to inform this review.
- A comprehensive report of performance against SLAs and KPIs is produced on a four-weekly basis. This is in a multi-tab spreadsheet format requiring a deep understanding of the service characteristics in order to interpret the content.
- A *Service Improvement Plan (SIP)* is a standard element in Service-based supply – this does not appear to be present & would form the basis for all improvements (in addition to capacity/technical continuity/refresh action.

4.8. Security

The contractual security requirement is set out at a high level, the onus being on the Concession supplier to take an appropriate security stance and implement a set of controls commensurate with the nature of the data processed and wider service level obligations.

A full security assessment is not part of this short review exercise though our current view is that, on the evidence seen, the system has procedural and personnel controls in place that are appropriate for data at an OFFICIAL level.

A summary of the controls seen is as follows:

- Access Authentication mechanisms for users and for REST/SOAP APIs.
- Certificate and password management regimes.
- Use of HTTPS to the system security boundary.
- Dual firewall architecture.
- Physical separation of equipment in the secure colocation facilities.
- Segregation of development and test services from the rest of Landmark.
- Security patching good practices.

- Code and release management good practices.
- Periodic, usually annual, security penetration tests.

As part of preparations for re-procurement the Authority should formalise the security classification for the service, particularly to determine whether any data to be held should be classified at OFFICIAL-SENSITIVE. This would provide any supplier with clarity on the level of controls required for that element of the dataset. Additional controls might include, for instance:

- Encryption of (selected) data 'at rest'.
- Encryption of inter-Data Centre (replication) traffic.
- Security incident event management (SIEM) processes and tools.

4.9. Service Support

Support services for the EPBR infrastructure and software is drawn either from the original end manufacturer (OEM) or an authorised 3rd party reseller and service provider. Choices are typically driven by the support models available, whether the product is in regular need of extended support, support hours, cost and quality of service.

Current support arrangements as identified in the Asset Register are as shown in the following table:

Component Supported	**Support Vendor**
Hardware	
Storage Switches	101 Data Solutions
Linux Servers	101 Data Solutions
Virtualisation Servers	101 Data Solutions
Firewalls (Cisco)	Softcat
Firewalls (Fortinet)	Fortinet
Network Switches	Softcat
Storage (and software)	EMC
Software	
Register and DW Database	Oracle
Virtualisation	VMWare
Business Objects	itelligence
Backup	Veritas
Address Database	Experian/QAS
Open Source	Communities

This mix of support routes is typical for a system with the multi-supplier technology base on which EPBR is implemented. If as anticipated the next generation system exploits Cloud technology the support routes are consolidated and simplified.

4.10. Volumetrics

Detailed service usage statistics are provided to the Authority as part of the four-weekly SLA-KPI reports. We understand that the overall usage trends are slightly down year on year which, if projected to continue, helps to mitigate risk over the next residual contract and transition period.

A summarised snapshot from the report for SLA-KPI report for the period ended 27th January 2018 reflects the following capacity and usage statistics:

Component	%Full (Approx)
Data and Storage	
Storage Area Network	55%
Long Term Object Store	21%
VMWare Storage	57%
Register Database	40%
Data Warehouse Database	30%
Address Matching Database	20%
Compute Memory / CPU (monthly average for CPU)	
VMWare	67% / <10%
Register Database	92% / <10%
Data Warehouse Database	88% / <10%
Address Matching Database	12% / <10%

The key 'takeaways' from this picture, considering the stated trends in business workload is that:

1. Storage capacity should not require any increases..
2. Register and Warehouse Database servers have very high memory utilisation.
3. VMWare servers have high memory utilisation.
4. CPU utilisation averages are low, though peak utilisation (a more important metric) is not reported.

Whilst SLAs and KPIs are currently being satisfied points 2 and 3 are addressed further in the following section of this report focusing on the Lifespan of the current system.

Usage profiles by user types are recorded and reporting to the Authority through the regular SLA-KPI reporting mechanism.

4.11. System Documentation

The status and qualify of the EPBR system documentation is not untypical for a system of this size, complexity and maturity. There is sufficient information available for the supplier to manage and operate the service, for industry engagement around regulatory and functional change and for MHCLG governance. However, these information assets are fragmented, some are not up to date, apparently not coordinated across the suppliers teams involved in running the service. There is a latent risk to continuity of the 'knowledge base' should there be, for example, a sudden increase in attrition of Landmark

personnel. Consequently some improvements and uplift in documentation will be required from the supplier as part of the contract Exit arrangements, to underpin any procurement and service transition.

The full list of service documentation collated and reviewed is provided in Appendix A The system and technical documents providing most significant input to this system summary, and into subsequent observations and recommendations, are as follows:

	Document Title	Content / Relevance
1	20180228 Domestic EPC Register Services v7.0	Business service definitions
2	20180228 Non-Domestic EPC Register Services V10.0	Business service definitions
3	EPC High Level Software Architecture v1	Application Software Architecture
4	(Various) Software Stack Architectures	Software Deployment Architectures
5	Registers Network Diagram v2.2	Network Architecture
6	(Various) Database Schemas	Data Architecture
7	Solutions Agile Development Model	Software Delivery Lifecycle
8	Registers Estate v4.17	Asset Register and potential refresh requirements
9	Service Management Process Models for Change Management and Asset Management	Capability Maturity
10	(Various) SLA KPI Four-Weekly Reports	Utilisation trends
11	LIG/Viewdeck Meeting Notes	Gap filling

4.12. Tools & Technologies Out Of Scope

Our discovery activities identified that a number of tools and one core infrastructure item that support the overall service provision are not part of the dedicated MHCLG EPC Register network. In general terms these are the common tools that Landmark use to develop, manage and support service across their client base.

These items, confirmed by Landmark are as follows:

- JIRA - requirements management tool
- Developer Workstations
- Code Repository - on-premise Gitlab instance
- Application deployment tools
- Ready API - QA Testing tools
- JENKINS - Application Lifecycle Management
- Password Repository
- Paessler PRTG - availability and capacity management and monitoring tool
- Zendesk - Service Desk tool
- DBA tools and scripts
- SysAdmin tools and scripts
- Inter Data Centre network link - see the Hosting summary above.

The precise contractual position needs to be established prior to procurement. Whilst the tool instances and licenses utilised may be drawn from Landmark's own arrangements there may be an obligation to provision separate instances, dedicated and owned by the Authority, for contract exit purposes. As an absolute minimum data extracts and knowledge transfer will be required.

4.13. System Specification Observations

	Observation
SOB01	Moderately complex software and data models, driven by variations in regulatory base.
SOB02	Long change cycle, constrained by regulations and industry engagement obligations. Other public sector organisations are using innovative ways to foster collaboration with industry and speed up change.
SOB03	Software delivery utilises some agile practices, though ultimately constrained by the regulatory change cycle.
SOB04	Technology based primarily on high-end, premium priced products 'of the day' when system originally designed.
SOB06	Security stance and controls implemented are broadly commensurate with an OFFICIAL data classification. This needs to be formalised prior to procurement.
SOB07	System documentation fragmented and incomplete, not satisfactory for service procurement and/or transition.
SOB08	Storage capacity over-provisioned in context of service level requirements, hence capacity for growth over system 'twilight' period.
SOB09	Platform generally refreshed in step with typical industry benchmarks, though database servers, SAN switches and the virtualisation platform are at or are approaching end of life..
SOB10	Register Application Java based software is portable to other platforms, including Cloud IaaS/PaaS. Potentially significant rework required for Oracle Stored procedures and Oracle APEX configuration applications.
SOB11	Data volumes are significant, in order of 60 Terabytes allocated.. Whilst not large in wider industry terms, some careful consideration of transfer options is required prior to any service migration.
SOB12	Data models and types follow industry standards, though structures and relationships are moderately complex, hence thorough planning and rehearsals required for migrations..
SOB13	Overall architecture is mature and stable, technology has been refreshed without changing the basic architectural structure, hence potentially disruptive if changes were made.
SOB14	'Hidden' impact of change due to use of Landmark owned service management and operational tools. Precise contractual obligations on Landmark needs to be determined, or assumption made, prior to procurement.
SOB15	Support contracts maintained to date with a few exceptions. Significant reliance on 3rd Party supplier market for support of some ageing infrastructure components.
SOB16	Interfaces and services provided to Schemes, Users and the software they may employ is well specified. This presents opportunities for other providers to deliver the service with alternative systems and environment.
SOB17	Some of the standard elements of a service-based supply contract, e.g. a Service

	Improvement Plan, are not present.
SOB18	Current 3rd Party support arrangements are typical for a system of this type which is built on a range of products, of various ages, from different suppliers. A likely future Cloud based system will have simpler support channels.
SOB19	Service capacity and performance monitoring tools focus on infrastructure and on the contracted SLA measures. There is no method of monitoring and assessing the overall end-user experience, generally a prerequisite for modern digital systems.

5. Implications for the Future

5.1. Lifespan

5.1.1. IT Market Context

This section assesses the residual life and capacity of the EPBR solution through to March 2020, and potentially beyond, as an input into finalisation of the procurement approach and consideration of extending the current contract. It builds on the understanding of the solution as set out in the preceding section focusing on the longevity, capacity and supportability of the key system components.

While 'Residual Life' is often driven by cost to support (including security), rather than real technological obsolescence, we focus on technological obsolescence and security risk as 'cost to provide' is very sensitive to commercial positioning and offers from suppliers.

As general context it is worth understanding some 'rules of thumb' as to what constitutes 'Useful Economic Life' for IT equipment. Whilst the financial depreciation period is set at 3 years for most enterprise class infrastructure, for replacement planning purposes useful life is typically as shown in the following table. Against these industry yardsticks the average age of the ERP estate is shown as at December 18 (end of current contract) and at December 19 (the end of a potential 1 year extension).

	Industry Average	***EPBR Estate Average @ Dec 18 / @Dec 19***
Servers	3 to 5	7/8
Firewalls	5 to 7	5/6
Network Switches	5 to 7	1/2
SAN Switches	5 to 7	5/6
Storage Systems	5 to 7	5/6

This is a summary view, there are individual pieces of kit that are older than the estate averages.

Factors that impact the actual longevity include:

- how heavily, or not, the infrastructure has been utilised
- how well it has been maintained
- ability to obtain support (and spares), including security updates, either from the original vendor or a 3rd party
- continuity of compatibility with required software
- ability to support the ongoing business needs, for example against an increase in business capacity forecasted.

If equipment has not been over-utilised, has been well maintained, spare parts are readily available (particularly 'moving' parts such as hard discs), the software running on it is in support, including security patches, and has sufficient capacity for projected business needs then there is no reason why it should not be retained well beyond the industry benchmarks.

The stance taken by MHCLG should be informed by a deeper assessment of impact, options and risk than has been possible during this review. The appetite for risk must be considered in relation to a pragmatic view on how long procurement and any subsequent supplier transition will actually take.

5.1.2. Capacity

In considering system capacity for the next two years the following factors need to be taken into account:

- At the last refresh of system processing and storage capacity a significant over-capacity provision was included, in the anticipation of future growth and to mitigate the need for repeat upgrades.
- In terms of response times the system is comfortably meeting KPIs, which indicates that either processing capacity is over-provisioned and/or the KPIs are not tight enough.
- The year-on-year trend for Lodgements (new and changes) is down. Against this the impact of latent regulatory change is unclear at this stage.

Landmark's instinct is that there is sufficient system processing and storage capacity to cope with workloads through until the end of 2019. Whilst precise trends cannot be quickly interpreted from the statistics available, Viewdeck would concur with the view from Landmark hence not recommending any specific actions to increase capacity. Normal capacity monitoring and management processes should, of course, seek to proactively identify trends, potential hot-spots and risk mitigations.

5.1.3. Technology Heat Map

We have assessed each hardware and software asset in the Asset Register, which was updated by Landmark to include additional information specifically to support the assessment, in order to inform the potential need to refresh or remediate any assets prior to the end of the current contract.

A summary of the output from this assessment is represented in the following table:

Component	2018	2019	2020	2021	Notes
Application Tier					
Domestic Web Application					• Currently on JEE v7, no forecast need to upgrade (v8 announced 08/17) during this period.
Domestic Configuration Application					• APEX compatible with Oracle Database versions used, no risk through 2018/19. • Configuration Apps would need rewritten if new solution not using Oracle.
Non-Domestic Web Application					• Currently on JEE v7, no forecast need to upgrade (v8 announced 08/17) during this period.
Non-Domestic Configuration Application					• APEX compatible with Oracle Database versions used, no risk through 2018/19. • Configuration Apps would need rewritten if new solution not using Oracle.
Shredder / Loader Application					• Currently on JEE v7, no forecast need to upgrade (v8 announced 08/17) during this period.
Registration Application					• Currently on JEE v7, no forecast need to upgrade (v8 announced 08/17) during this period.
Reporting Application					• SAP Business Objects, v4.1 current supported to 12/29, upgrade or replace.
Address Matching Application					• Experian / QAS, mature product with wide market base.
Development and Support Tools					• Dev / Support tools considered Landmark assets, by Landmark, hence not transferable.
Application Runtime					• Apache Open Source software, long term Community support. Upgrade in due course.
Database Tier					
Domestic Register Database					• Current support contract expires 05.18, must be renewed. • Oracle Extended Support for v12.1 runs to July 2021
Non-Domestic Register Database					• Current support contract expires 05.18, must be renewed. • Oracle Extended Support for v12.1 runs to July 2021
Data Warehouse Database					• Current support contract expires 05.18, must be renewed. • Oracle Extended Support for v12.1 runs to July 2021
Long Term Object Store					• EMC Centera - no end of life announcement, though technology is largely superseded.
Address Database					• Integrated 'back box' solution with Address Matching Application.
Technology and Hosting Tiers					
Linux Servers (IBM)					• Database servers (primarily) estate averages 6 years old. Withdrawn from market in 2014, 3rd party support only for several years. • Selective refresh and remediation to be considered.
Windows Servers (Dell/EMC)					• Backup management servers, now 5 years old.
EMC Storage					• Potential end of EMC standard support 12/19, no announcements on extended support options yet.
Network Switches (Cisco)					• Replaced in last 6 months.
Storage Switches (Brocade and IBM)					• Brocade 4100 switches were End Of Life at time purchased. In 3rd party support only. • *Consider refresh and remediation.*
Virtualisation Platform					• VMWare 5.5 (current) goes End of Life 09/18, possibility of limited duration extended support. • VM Host Servers (HP) now 8 years old.
Backup System (Veritas)					• Hardware in support. • Software needs upgraded to stay in support 2020 onwards.
Firewalls (Cisco and Fortinet)					• Firewalls reached End of Life in 2017, though still supported through 2021. • No new security signature updates from 08/20.
Operating Systems					• RHEL 5 End of extended support 10/20. • CentOS 7, updates through 06/24. • Windows Server 2008, supported until 01/20
Data Centre Network Interconnect					• Landmark shared asset, deemed not transferrable.

The primary time window against which the 'fitness' of the technology was considered was to March 2020. However, this has been projected out until the end of 2021 in order to provide a perspective for any slippage in procurement timescales or to address any risks to service continuity associated with a new supplier taking on a 'burning platform'.

The simple heat-map colour coding reflects:

- Green – no refresh or remediation required
- Amber – possible refresh or remediation required.
- Red – probable refresh or remediation required.

Looking at the assessment for 2018 through 2019 it is clear that the primarily in the 'green zone' hence in good shape to deliver the required level of service through that period. However, there are some system components that are beginning to present risks that must be addressed:

Servers – EPBR runs on a mixed estate of servers from a small number of 'tier 1' suppliers, IBM, HPE and Dell. These servers were purchased across 2010-2013, most withdrawn from the market by 2014 and now supported only through 3rd party service providers (currently 101 Data Solutions – Prodec). All are beyond the industry yardstick of 3 to 5 years of useful life potentially due to low levels of utilisation and being well

supported, though mean-time-between failure statistics are decreasing (getting worse) for some devices – specifically the database servers, which would be expected to be most heavily utilised in what is a data processing intensive system. The servers supporting the VMWare Virtualisation platform, see below, includes the oldest in the estate, purchased in 2010. We concur with Landmark's view that some remediation action should be considered, hence a full impact and options analysis of the current situation should be undertaken. This should include scenarios to consolidate existing estate capacity as alternatives to purchasing new kit, recognising that there may potentially be a need to relax some service performance targets in order to do so.

Storage Switches – these are the Brocade and IBM switches that provide fibre-optic connections to the EMC storage systems. Indications are that the versions installed (Brocade 4100) had reached End of Life when obtained, hence no longer supported by the original manufacturer and reliant on 3rd party supplier services. The rate of failures has been increasing and support more difficult. It is not clear why these switches were not replaced when the storage systems were subsequently upgraded. We concur with Landmark's view that remediation should be considered after a full impact assessment is commissioned.

Virtualisation Platform – the VMWare platform, on which most of applications are hosted, is at risk from both it's obsolescent servers (see above) and as the software version (5.5) reaches EOL on 19/09/2018. This virtualisation provides resilience, scalability and flexibility in the current services but also the potential to ease a migration of the applications to a Cloud platform, so should be considered from the context as an enabler in addition to a sunk cost. From the software perspective the options are to either upgrade to version 6.x or purchase extended support, which is available in 1 year increments up to 2 years. Important to note that extended support is limited in scope offering only an annual security patch for catastrophic/critical fixes and bug fixes for severity 1 failures; it excludes product maintenance or updates. A detailed impact assessment considering both options should be undertaken, in conjunction with the server impact assessment as there will be dependencies.

Looking ahead through 2020 and into 2021 the status of more components begins to 'flash amber'. Whether or not remediation action is required will depend on the outcomes of procurement. It will be prudent to make some financial provision for technology refresh spend during the latter half of 2019/early 2020 in case there is a need to safeguard service delivery over a transitional period.

5.1.4. Lifespan Observations

	Observations
LOB01	The EPBR service is technically capable of running through to the end of 2019 and beyond if : ● hardware and software stays in support (including supply of security updates) ● the (stable) architecture is not destabilised through change ● there is no major change to the business workload on the system.
LOB02	It is assumed that all support contracts, hardware and software, due to expire in 2018 will be extended to 12/18 or the end date of any contract extension, if a decision is made in time to inform support negotiations.
LOB03	Ensure that key 3rd party support service suppliers, particularly 101 Data Solutions (the primary infrastructure support provider) are engaged early to check the viability, and cost, of supporting the ageing estate through to 2020.
LOB04	Commission Landmark to provide impact assessments for remediation of Database server estate, SAN switches and the VMWare hardware and software platform. Consider these impacts in conjunction with the outcomes from assessing the ability to extend support arrangements for the existing estate.

LOB05	Restrict the amount of business change implemented to regulatory change and resolution of highest priority bugs. This will help to protect the existing platform from change, permit Landmark to focus on sustaining the service and potentially reduce some operating costs.
LOB06	The VMWare virtualisation platform could significantly facilitate migration of the existing service applications (not databases) to a Cloud platform. An up to date and fully supported platform may be an enabler for a transformation of the service, dependent of course on the suppliers target solution.
LOB07	The effect of Moore's Law means that any replacement servers will be significantly more powerful and provide better performance that the current estate. Hence a small overall 'footprint' will be required though recognising the need for resilience through redundancy in the architecture.
LOB08	In making investment decisions for the residual period of the current contact and any extension consider the transition to a new supplier/contract, it may be necessary to remediate some components in advance in order to reduce risk.
LOB09	An alternative view to investing to reduce risk is to use those risks to drive a more aggressive transformation of the platform, whether on a like-for-like basis and/or to utilise Cloud capabilities, through the new contract and supplier.
LOB10	The Landmark team supporting EPBR is small in numbers. Some of the same resources who provide support will likely also be required to respond to the Exit notice being served and to support a bid by Landmark for the new contract. This is Landmark's risk to manage though the Authority should be aware of it.
LOB11	Consider relaxing some NFRs, e.g. zero data loss, to potentially allow spare capacity to be used to remediate failed components.
LOB12	Consider an embargo on any extended use, from current baseline, of Oracle proprietary features particularly Stored Procedures and Application Express, other than in exceptional circumstances, e.g. resolution of Severity 1 problems.

5.2. Transition of Existing to New Management

This section considers whether the EPBR solution could be transitioned (in situ) to an alternative supplier and to identify any potential issues arising in terms of people, process and technology.

Note that whilst any Managed Service can be transitioned, whether it is cost-effective to do so depends on competitive pricing, and risk, that can only be judged during the procurement process. A market pre-engagement exercise would inform the appetite across the potential supplier base and help shape a procurement approach.

Our view is that an in-situ migration, if viable in terms of cost and risk, should only be considered as a stepping stone to a) remediate any 'burning platform' obsolescence issues then b) used the stabilised platform as a basis for service improvement and transformation. However, we understand that some uncertainties over the medium to longer term regulatory context makes the business case for a concession based contract challenging in these circumstances..

Therefore the feasibility and opportunities are addressed from the perspective of practicalities, transitional solution scenarios, knowledge, asset ownership and logistics (rather than cost-effectiveness).

5.2.1. Transition Objectives and Planning

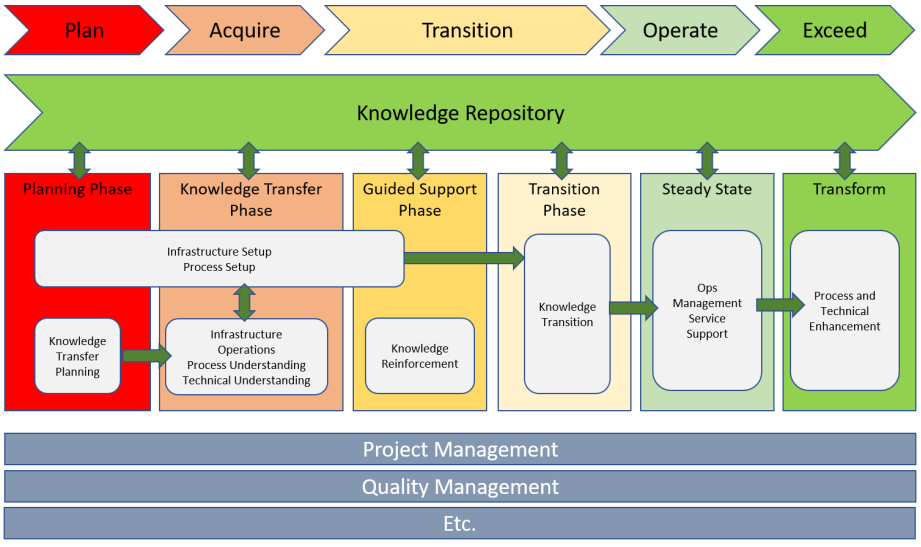
As context, a typical set of simple objectives for a service transition are as follows:

- No disruption or deterioration in service.
- No adverse impact on customer experience.
- Successful migration of data to any new system with no loss of data integrity.
- No depreciation of system security.
- Timely provision of all required system and service documentation, of required quality.
- Cooperative planning and execution between service providers and the Authority.
- No loss of intellectual capital.
- All assets, licenses and third-party service contracts are transferred, novated or replaced.
- Any new service components and capabilities are in place and ready.
- People impacted by the changes are treated fairly.

Contract and service transition is a 'bread and butter' activity associated with almost all outsourcing and managed service initiatives. Any prospective supplier interested in bidding for the EPBR contract would clearly need demonstrable best practice transitioning capabilities (people, process and tools), with referenceable experience in the takeon of similar sized and shaped services.

From our experience in contract transition with perspectives of an exiting supplier, new supplier and acting for an authority we would broadly rate the EPBR transition as moderately complex but of moderate to high risk. Whilst the technology baseline is relatively narrow and utilising commonly used products, the age of key platform components (if not remediated), the long-term duration of the current contract, system knowledge deeply embedded within Landmark the supplier all serve to increase the risk factor. Whether relatively simple or very complex, transitions involve multiple stakeholders and a certain amount of time and expense.

A generic representation of a managed service transition model is shown in the following diagram:



Such a multi stage methodology would be tailored to specific needs of an EPBR transition.

Successful transitions begin early with coordination and planning, which MHCLG have recognised through inclusion of an Exit Plan in the current contractual obligations and also through this short assessment of the position. It is however important for the Authority to 'ramp up' planning and preparation activities as part of procurement,, in the context of a number of potential transition scenarios that could arise.

5.2.2. Transition Considerations

There are typically three stages to contract and supplier transition:

1. New supplier 'Walk In' and takeover
2. Migration to new supplier facilities
3. Service improvement and transformation.

Note that the boundaries between the stages are not clear cut, for example some some initial migration activities may occur (indeed may be essential) during a Takeover period and service improvements can be made as part of Migration.

Takeover - in this model the new supplier effectively takes control of the existing service with the minimum viable change. Such an approach is usually predicated on the outgoing supplier working in support of the new supplier during a period of familiarisation, with phased succession of resources outside of TUPE with new supplier resources. The service continues to operate 'as is' though contractual responsibilities and accountabilities, including commercial/financial aspects, have changed. From a technology perspective the minimum viable changes, which could be handled over a period of time subject to arrangement between suppliers, are in these areas:

- Decoupling of dependency on shared Data Centre network interconnect.
- Software development and support migrating to new supplier processes and tools.
- Shared system management and monitoring tools replaced
- Financial and commercial reporting.

Migration - this stage may follow a period of Takeover, alternatively it can be executed directly from the prior supplier to the new supplier without a Takeover. The outcome is that the existing system is now running fully in the new suppliers facilities. In addition to the minimum viable scope of migration referenced above the outcomes stage would address the fuller set of activities including:

- Migration of physical infrastructure from current to new supplier Data Centres, alternatively the build-out of an equivalent platform using alternative infrastructure replicating the existing system architecture.
- Migration of the application services, potentially enabled through the use of virtualisation technology (see the System Assessment and Lifespan sections above).
- Migration of the databases and long-term data-store content (see below for an expansion on this element)
- Full integration with the new suppliers system development, management and security capabilities.
- Transfer of all information assets.
- Final transfer of people.
- Formal cessation of prior supplier engagement.

The technology may involve the replacement of obsolescent technology not remediated prior to the new contract, if that is deemed to be a major risk to the service during the migration period.

It is anticipated that any new service provider will be highly experienced in undertaking safe, secure and cost effective migration of services from other suppliers into their own dedicated or shared facilities. Potential options that the supplier(s) and Authority may wish to explore include:

- Utilise disaster recovery capabilities in the secondary data centre to facilitate migration, potentially temporarily reducing/suspending some SLAs.
- Vertical phasing -migration on a scheme basis, Domestic and Non-domestic.
- Horizontal phasing - migrate the web and application tiers first, then the data tier.
- A big- bang migration of all components at the same is likely to have a significant impact on service availability hence is not recommended.
- A phased approach may require some interim engineering workarounds, as some components of the architecture are shared between Register services. This will generate costs and risks to be managed.

Clearly it is essential that any migration plan adopted should be well rehearsed and have regression/roll-back incorporated in case of unexpected problems arising.

Data Migration - The transfer of EPBR data from the existing data centres to a replacement facilities requires careful consideration of the challenges, risks and options available. From the Landmark SLA-KPI report for the period ended 27/01/18 the used storage capacity is in the region of 65 Terabytes across databases and long term object store. Recognising that not all of this data will necessarily need to be migrated a rough order of magnitude calculation is:

65 Terabytes @ 1 Gigabit-per-second = **134 Hours** to transfer over a network

There are established, proven methods to reduce data transfer times. These should be proposed by suppliers sighted with the data volumes through the procurement exercise. Potential options include:

- Service based migration, i.e. Domestic and Non-Domestic data separately..
- Age based migration, e.g. 'background' migration of older lodgment records from the long-term object store.
- Use of high-volume portable data transfer devices.

Data Quality was highlighted as an issue through the Discovery initiative preceding this technical review. It is assumed that the Authority wishes to respond to the weaknesses identified, though that no major changes are likely during the residual duration of the the current contract. This review has not investigated into where data is considered low quality or the root causes, though there are typically two threads to an improvement plan:

1. Cleaning up existing data, automating as much as possible through use of data quality tools.
2. Preventing capture of more lower quality data through enhanced validation and application of stronger business rules at the data capture stage.

Automated data cleansing could, in theory, be carried out as part of data migration though Viewdeck would not recommend this as the ability to compare data sent to data received becomes more complicated undermining the ability to assure the migrations.. It is recommended that any bulk, tool based data cleansing activity should be undertaken post migration as part of service improvement and transformation initiatives. Of course 'point' or smaller scale cleansing can continue to be actioned through business as usual change processes.

Both Data Quality and Migration should not be a particular area of concern subject to adequate planning, rehearsal and assurance that data is successfully migrated without any loss of integrity.

Service Improvement/Transformation - scenarios for major improvement and transformation of EPBR is covered in the Futures and Next Generation sections of this report. However, as indicated previously the boundary between migration and transformation is porous so it is possible that some more transformational steps could be delivered in conjunction with migration. Suppliers may, for instance, propose the use of some Cloud based services to support the current solution rather than continuing to invest in dedicated, on-premise capabilities. Some potential example include;

- Migration of suitable architecture components to the Cloud rather than to dedicated infrastructure, the Java and Open Source based application components being one candidate.
- Deployment of a new web front-end (demand signals for which have been signalled through industry groups) via a Cloud platform, integrating with on-premise back-end application and and database services.
- Using Software as a Service (Saas) tools to manage and monitor the EPBR service.
- Replacing the on-premise Address Matching components, from Experian/QAS, with the Cloud SaaS version of the product or equivalent from an alternative provider, e.g. OS Places
- Using Cloud services for backup and archive of EPBR data.

5.2.3. Transition Observations

	Observations
TOB01	The EPBR service could be transitioned to another supplier, whether it is cost-effective to do so depends on competitive pricing that can only be judged during the procurement process.
TOB02	Transition of service in-situ is an interim state, should be considered a stepping stone to a service transformational.
TOB03	It is assumed that all licenses and support contracts can be novated, transferred or replaced though the impact (e.g. charges) is unknown. *This needs to be better understood prior to procurement.*
TOB04	Landmark Domestic and Non-Domestic Exit Plans (v0.4) document, last updated in 06/15, are activity lists rather than plans. More work is required, collaboratively with a new supplier, to develop comprehensive plans.
TOB05	The Authority has pivotal role and responsibilities in orchestrating and assuring a transition plan, collaborating with existing and new suppliers. This is a major task which needs to be planned and resourced early.
TOB06	The need for continued support from Landmark during Takeover and Migration stages is recognised in the draft Exit Plan, though loss of skilled resources due to contract termination may weaken capability to provide required support.
TOB07	A relatively small number of Landmark staff carry the deep knowledge of the EPBR system. Regardless of how the current documentation is improved for procurement and transition purposes the attrition of key staff would increase the risk to successful outcomes. Some form of incentivised 'lock in' for a transitional period should be explored.
TOB08	A 'big bang' migration of the EPBR in-situ is highly unlikely to be viable, therefore anticipate a phased migration, for example Register service type or by architectural tiers.
TOB09	Phasing may require some interim engineering workarounds as the Register services consume some shared architecture components, i.e. a cost.
TOB10	The volumes of data to be migrated requires a well thought out strategy, thorough rehearsal and in-built, automated assurance to ensure no loss of data or data integrity.
TOB11	Do not seek to conduct a bulk data quality improvement exercise during the data migration process. Do it beforehand or, preferably, post migration as part of service improvement and transformation initiatives.
TOB12	Minimum viable changes are replacement of Landmark owned assets, primarily development and support tools (see Tools and Technology above) and shared Data Centre network link.
TOB13	Consider testing the market interest and viability of transitioning through a pre-engagement activity.

5.3. Evolution

This section considers how a future EPBR solution could be designed to flex according changing policy needs and market activity. In addition, it also takes the opportunity to consider areas where change may be required that are not driven by policy needs or market activity such as feedback from consultation with EBPR Stakeholders. The influence of and recommended response to GDS Guidelines and Requirements is covered in *Key Requirements for Next Generation*.

The role of the EBPR is changing. While the original purpose was focused on assurance and administration of energy Certificates at an individual building level of precision, a variety of stakeholders (including public and private sector) have identified that the same data (and extensions to it) could play a valuable role in Decision-Support. The Decision-Support role would require availability and analysis of large quantities of data to new Stakeholders, Agents and Users in support of a variety of decisions (e.g. Policy-making, country/region assessment of building stock).

Policy needs, market activity, stakeholder feedback and GDS guidance present a diverse set of drivers that do not lend themselves to summarisation, so they are individually considered in the sections below. However, several themes that recur and are worth highlighting:

- **Uncertainty** – requirements are articulated as possibilities, with no firm commitment to require implementation. Under these circumstances, and with expected financial & budgetary constraints it is not reasonable for MHCLG to commission and fund speculative action in preparation for the changes when they become defined.
- **Absence of actionable clarity of requirement** – requirements are articulated at a very ambiguous and high level (typically no more than 2 or 3 sentences), subject to significant variation in interpretation.
- **Timescales for emergence of clarity** – clarity and certainty will emerge from distinct requirement sets on different timescales (e.g. Brexit-related beyond 2019, Grenfell Review actions from Q4 2019, SAP Review Actions from Q4 2019, Address Improvements Spring 2019). However, given the maximum lifetime and timing of the Landmark contract and the strength of the drivers, introducing an implementation response to the existing service/system would create significant risk, especially as it is normal practice for service providers wind down and redeploy their development/change teams towards the end of a contract.
- **Trade-off between ROI and Early Capability Deployment** – arising from the 'Timescales for emergence of clarity' item above, it is unlikely that investment in the existing system to incorporate richer features, functions, data schemas, digital interfaces or user interfaces will deliver an adequate return.
- **Uncertainty over funding of changes** – sources and magnitude of funding available for implementation of emerging requirements is not known.

A significant number of drivers imply the need for greater interoperability & extensibility rather than introducing any new or complex business rules & logic. This in turn points to more specific focus on Architecture Standards and Integration & Extension Toolkits to minimise the cost, risk, disruption and turnaround time for emerging requirements.

Taking all available policy drivers and market trends into account, it is quite possible that the existing system *could* be adapted to respond in the same way that it is able to respond to user/stakeholder-driven requests for improvement (e.g. to Address handling). Whether it *should* be adapted will depend on an economic judgment based on cost-effectiveness – this can only realistically be tested through a procurement process. It is unlikely in the extreme that re-implementing existing capabilities in an alternative technology system would be cost-effective – such an approach would only make economic sense as an enabler of a significant degree of change and folded into a broader contract.

To enable an informed decision, such a significant degree of change would need to be based on clearly articulated requirements, certainty of the need to implement, certainty over the lifespan of the service (in order to spread fixed costs – e.g. of transition & migration and certainty of the availability of funding. These same criteria would need to be met for the service provider market to take an interest in bidding and drive real competition during the procurement & selection process.

In response to all the above, Vlewdeck propose the following recommendations:

[**Recommendation #1:** MHCLG should recognise that the current conditions do not lend themselves to driving sufficient interest in the marketplace to ensure real competition or a compelling business case for re-implementing the existing system capabilities in a new system]

[**Recommendation #2:** MHCLG should closely monitor and influence the specification of requirements on EPBR, noting that this means a significant degree of 'solutioning' in response to emerging large-scale/strategic drivers in order to optimise decisions]

[**Recommendation #3:** MHCLG Bidders should be asked to propose a parametric pricing model for such changes that MHCLG can then test against a standard set of internal assumptions and hold the provider to account come the time that change is required]

[**Recommendation #4:** MHCLG should define a set of detailed Architectural Standards that promote flexibility in each of these impact areas that do not require significant investment to deliver – note that these will have a lot in common with the content of 'Technical Design Requirements & Constraints']

5.3.1. Policy Needs

'Policy' is interpreted for the purposes of this section as meaning policy changes that are directed or channelled through central UK Government. These policy areas and implications analysis are as follows:

1. **Non-specific Policy Aspirations** – including ECO, Renewable Heat Incentive, Feed In Tariff, Fuel Poverty, Climate Change Act, Green Mortgages, Stamp Duty Changes. No precise statements of reliable intention are available for any of these areas. A reasonable working assumption at this stage is that these areas are not likely to significantly affect the database schema (i.e. the data collected and managed by EPBR) or business logic (e.g. business rules, business processes). This means that the impact of any emerging requirements in these areas would be limited to (but could still be significant):
    a. **Capacity** – including volume of persistent data, transactions & network bandwidth
    b. **Interfaces, Access & Security** – to make information available to new Agents
    c. **Quality** – e.g. to provide a sound enough basis for new types of decision (including potential need for evidential quality). Quality management may require significant change in validation rules (e.g. data integrity) and quality management tools.
    d. **Form & Presentation** – the way in which information is made available for consumption

    [**Recommendation #5:** MHCLG should define a set of assumptions for each policy areas and ensure bidders are asked for detail on how they will cater for them - this will provide a common reference point against which to transparently and consistency evaluate proposals]

2. **Green Deal** – this is mainly a historical policy area where the impact on EPBR is considered to have been completely implemented.

3. **Private Rented Sector** – focused on mandating and phasing in minimum energy efficiency standards. This is unlikely to have significant impact on EPBR – it is more focused on external use of EPCs based on the existing rating scheme.

4. **Clean Growth Strategy** - the UK Government published its Clean Growth Strategy in October 2017. This set out a general aspiration for the existing housing stock to achieve EPC Band C rating by 2035, with the intention for fuel poor homes and homes in the private and social rented sectors to achieve this standard by 2030. The Strategy also announced that the Government would issue a Call for Evidence in spring 2018 seeking views on whether trigger points for EPCs could be extended and on how EPCs could be further improved in the light of new sources of data and capabilities. This is unlikely to have significant impact on EPBR – it is more focused on external use of EPCs based on the existing rating scheme.

5. **Digital Land/Geo-Spatial Land Transparency** – the UK Government is taking forward plans to create a comprehensive geo-spatial data body within Government – the largest such repository in the World. This new body would set standards to digitise the planning process. Proposals for a

Geo-spatial Land Transparency initiative (including use of energy performance of building data) are currently being considered. The impact analysis (and associated recommendations) of this policy area is similar to item 'Non-Specific Policy Aspirations' above – i.e. that the impact is likely to be in the areas of: Interfaces, Access & Security; Quality; Form & Presentation. Interfaces will be a particular impact area in order to support open interfaces to enable 3rd parties to locate and reference EPCs from Geospatial toolsets (normally involving 'layering' of filtered information.

6. **Brexit & EPBD3** – the EU is set to publish its third recast of the Energy Performance of Buildings Directive (EPBD3) shortly and the UK will need to transpose EPBD3 into domestic legislation regardless of its exit from the EU. The initial impact of Brexit itself is likely to be low as the UK simply repeals/inherits/adopts EU-originated regulations. However, EPBD3 may well require technical changes to the EPC Register and this will be examined once the final text is published by the European Council / Commission.

   [**Recommendation #6:** MHCLG should define a set of assumptions for each of these policy areas and ensure bidders are asked for detail on how they will cater for them. EPBD3 assumptions should be based on early sight of the text and/or market/stakeholder intelligence]

7. **Building Regulations (Fire & Safety)** - The Grenfell (Hackitt) review is likely to make recommendations for changes to Building Regs and use of building data for risk management. Clarity around requirement currently expected sometime in spring 2019, but likely to impact the Standard Assessment Procedure (SAP) for implementation commencing Autumn 2019.

   [**Recommendation #7:** MHCLG should anticipate the opportunity/requirement to significantly extend the EPBR data model (including capture & access) to record additional attributes of the buildings covered]

   [**Recommendation #8:** given the timing (and uncertainty of timing) of the Grenfell review, MHCLG should set expectations with UK Government that any resulting changes to the EPBR System and Service will not be made to the existing estate]

8. **SAP Review & Homebuying Process** - A review has just been completed into the SAP (Standard Assessment Procedure) assessment methodology for Domestic EPCs. Changes are already being planned to the the SAP XML schema and the EPC Register lodgement functionality. MHCLG has recently completed reviews into home buying and selling and improving the EPC and is currently digesting the responses. Results not yet available & may require changes to the EPC Register.

   [**Recommendation #9:** MHCLG should anticipate the requirement to marginally extend the EPBR data model (including capture & access) to record additional attributes to enable improved SAP and homebuying processes.]

9. **Accelerated Housebuilding** – UK Government is engaging with housebuilders to encourage acceleration of housebuilding with a target of building 1.5m Homes. This activity is unlikely to affect the nature of the EPBR system/service other than to increase the volumes of transactions (mainly lodgements, but also subsequent reference to the EPCs).

10. **Digital Economy Act** – includes a policy-level, but unspecific commitment to an increased need for Government to access public data. The need to share will have to be balanced with the need to protect, including restrictions imposed by GDPR and other privacy requirements. It is likely that the response(s) to this act would be for access to aggregated and summarised data to feed large-scale statistical analysis as well as coherent linkage and integration of individual items (e.g. via addresses, locations). There is not specific enough detail available to drive any ITT requirements other than focus on Interoperability standards and extensibility of Data Model. It is reasonable to assume that new requirements for data extraction & sharing will need to be met with system & service changes that require funding and commissioning.

    [**Recommendation #10:** MHCLG should assume that changes to the Data Model will be limited to minor extensions required to provide coherent cross-referencing and linking to other external

data. It should also assume that additional and potentially granular access will be required to EPBR data.]

5.3.2. Market Activity

1. **Smart Meters** - Smart Meters have the potential to provide granular data on patterns of energy consumption. However, such patterns would need to be correlated with occupancy patterns to reliably assess building energy efficiency. Such correlation will not be straightforward and there is no reason to believe that it would require significant changes to EPBR capabilities. Existing interfaces could be used to extract relevant information for use by external systems. It is also possible that the EPBR may be considered the best/most efficient system in which to record Smart Meter data. IN this case it is likely that Smart Meter data would need to be 'processed' by new software and then submitted in the usual fashion via an EPC lodgement.

   [**Recommendation #11:** MHCLG should take an early view on emerging Smart Meter standards and the implications of converging with EPC interchange standards]

2. **Self-Assessment** - the Energy Savings Trust estimates that a homeowner can perform a simplified energy assessment by answering 6 basic questions. While this may be technically possible, a number of challenges would have to be addressed to ensure the inputs were trustworthy and that self-assessors do not 'game' the system to deliver better efficiency levels on the EPCs that the property deserves. It is more likely that these 6 basic questions could be used for property providers to self assess with a view to deploying their own improvements – this would not substantively affect the EPBR itself.

   [**Recommendation #12:** MHCLG should assume that any technical solutions in the area of Self-Assessment are independent of the EPBR that deals with assured certificates]

5.3.3. EPBR Stakeholder Consultation

MHCLG consultation with stakeholders in the latter half of 2017 and the community engagement by LIG has identified a significant number of ideas for improving the EPBR system that are under consideration. MHCLG should note that the vast majority of these are not specific enough to form actionable requirements at this stage and have not been assessed for cost/benefit or prioritised. In this context, requirements emerging during the course of the LIG contract extension should be treated in a similar fashion to any other source of change requirement, including those covered by the above sections on *Policy Needs* and *Market Activity*.

A full list of change items encountered during this assessment is included in Appendix D. Areas for change include:

- Broader access to EPC data & greater utilisation in decision-support context
- Data quality improvement - especially the association between addresses, UPRNs and EPCs
- Data Model extensions – e.g. number of rooms in a property rather than just floor area
- Precision & codification – e.g. floor numbering of flats
- Related documents – e.g. photos of fascia
- Addresses – there are many ideas for improvement in this area, including:
  - Alignment with industry model (e.g. PAF format)
  - Postcode search & association
  - Address validation
  - New builds – specifically the change from initial 'working title' to final address
- Refresh of Web Portal to integrate with gov.uk and adopt GDS standards
- Navigation, Search & Find – e.g. finding assessors, business names, search without UPRN

[**Recommendation #13:** as suggested in *Lifespan Observations*, MHCLG should minimise further investment in the existing EPBR service/system to that absolutely necessary to provide an acceptable level of technical and business continuity.]

6. Alignment of Purpose With Service Levels

This section considers whether EPBR service levels have introduced avoidable costs (or have been unnecessarily excessive) and assesses the potential to make future cost savings by adjusting service levels. Precise judgment of 'excessive' in this context would need to be evaluated against Business Service Level requirements, apportioned between People Process & Technology and understanding the gap. At the time of writing, this degree of precision is not available, so the focus is to highlight areas where there may be opportunities to 'tune' the level procured (and level actually delivered if different).

Key materials informing this section of the report include the Service Specification schedules for Domestic and non-Domestic domains and SLA-KPI Reports. MHCLG should note that the NFRs in the Non-Dom Service Specification schedule don't appear to match the KPIs in the SLA-KPI Reports. Also that the Dom Service Specification omits a significant number and precision of requirements found in the Non-Dom Service Spec. For example, Dom does not specify any NFRs/Service Level Requirements (e.g. response times, availability) or contain any NFRs. The SLA-KPI Reports represent detailed snapshots of KPIS but do not plot trends that would enable projection into the future.

The Service Specification schedules contain language that suggests they were an input to a tendering process (e.g. "Any tender should reflect") – it is not clear whether the Service Level requirements and NFRs are those actually contracted for. The schedules do not specify the 'performance boundary' at which the performance and response time SLAs/NFRs apply (e.g. user experience, data centre).

Performance & Response Times
The performance & response times delivered persistently significantly exceed the targets contracted. It is highly likely that over-delivery of this magnitude has incurred unnecessary cost. This is likely to be a result of the supplier mitigating against the risk of failing to meet SLAs (and consequential Service Credits) by over-specifying Technical Capabilities funded directly by MHCLG. This behaviour should be viewed as a direct consequence of the shape of the existing contract (i.e. MHCLG cost, LIG risk) - this should be avoided in the future (see 'as a Service' Models later in this document). Examples include:

- *Submit and Lodge* – Service Spec Target Response Time of less than 1 minute with an average actually delivered of 7.5 seconds (worst case type of lodgement)
- *Retrieve and View* - Service Spec Target Response Time of less than 1 minute with an average actually delivered of 0.67 seconds
- *Lookup of Energy Assessor* - Service Spec Target Response Time of less than 15 seconds with an average actually delivered of 0.36 seconds

CPU, RAM & Persistent Storage
There is significant over-capacity in a number of areas, for example:

- CPU VMWare: 6.9% (although a better CPU metric would be peak load – this is not reported)
- CAS Storage: 27% used
- Live Data Warehouse (Data): 13.48%
- Live ESRI (Data): 14%
- Load ESRI (Data): 26%
- Data Warehouse RAM: 14% (not clear whether this is max)

As the cost and risk of deployment of Technical Capability (e.g. CPU, RAM, Disk) has already been incurred, it is unlikely that removing or reducing capability would deliver significant benefit while incurring an acceptable degree of risk. The approach taken to capacity provisioning means that avoidable costs have almost certainly been incurred, but not as a result of the contracted service levels & NFRs.

Availability
Contracted (and actual) availability is likely to be significantly in excess of required, however, architecting and provisioning of Technical Capability is normally done in 'units' of availability. The Technical Capability to provide 'Very High' (i.e. 99.99%) availability during operating hours (06:00-24:00 Mon-Sat) on this scale is likely to also capable of delivering 99.999% - i.e. the constraint is more around Service Management practices and scheduling downtime for maintenance.

Contract requirements are for a non-differentiated 'Very High' (i.e. 99.99%) availability (assumed to be during operating hours - 06:00-24:00 Mon-Sat) covering all system functions.

Given the measures in place for synchronous and asynchronous replication of data to a DR site, and the platform architecture of the live site (e.g. with real-time replication between DB Servers within the same Data Centre), the EMC solution addressing the 'Zero Data Loss' requirement is very likely to be unnecessary & at least not a cost-effective response to the requirement. At the same time, the requirement is articulated as a non-differentiated (i.e. 'blanket') requirement – this is partly what has driven the 'belt and braces' solution.

Capacity planning is not practiced with a normal industry-standard degree of requirements-driven precision or consideration of trending. Persistent storage problems are avoided through the over-provisioning of capacity based on a flat-line (i.e. similar year-on-year) cost of storage that relies on 'Moore's law' (i.e. doubling of capacity for the same price every 18-24 months). A beneficial side-effect of this approach is that there is likely to be adequate capacity to anticipate data growth in 2019/20 (although there are no formal projections defined).

[**Recommendation #14:** MHCLG should avoid significant change to the Technical Capability to tune Service Levels during the LIG contract extension period. The benefits of making the changes would probably not outweigh the risks to performance and business continuity during the contract extension.]

[**Recommendation #15:** MHCLG should only implement changes arising from technological obsolescence if the risks (e.g. to availability of failing components) can not be mitigated by the excess capacity present]

It is likely that tuning 3rd party (e.g. s/w vendor) support and LIG support arrangements is possible without introducing significant risk. At present the vast majority of 3rd party support contracts are for 24x7 4hr response time support – this is not necessary given the degree of over-capacity and over-resilience deployed. LIG would need to investigate whether 3rd party suppliers offer a tiered set of support arrangements (e.g. Gold, Silver, Bronze) that align with EBPR Service Level requirements, taking into account the 'belt and braces' approach to availability and response time assurance.

[**Recommendation #16:** As part of the LIG contract extension negotiation, MHCLG should request LIG to identify precise costs and risk (mainly availability/resilience and response times) impact of reducing the level of 3rd party support procured from technology vendors (software and hardware)]

7. Key Requirements for Next Generation

7.1. Service Levels, KPIs and Non-Functional Requirements

This section considers and, where appropriate, recommends changes to service levels and Key Performance Indicators to deliver an appropriate EPBR service. It also recommends additional functional/non-functional requirements to ensure the service can be managed appropriately and is able to adapt to changing policy requirements. Recommendations are focused specifically on the Service Management & Operations aspects of the EPBR system and areas where there are opportunities for reduction in all aspects.

As noted in the section on *Alignment With Purpose*:

- Performance & response times delivered persistently significantly exceed the targets contracted;
- There is significant over-capacity in a number of areas; and
- Contracted (and actual) availability is likely to be significantly in excess of required.

Contracted levels are now likely to be below scheme & user expectations as these will have been set by default to those delivered by the current system. The original levels may themselves have been too low and may not be suitable for the service in the future. Appendix C provides a detailed aggregation from three key sources of the operations/services provided to Actors/Users by the EPBR System (Schedule 2, SLA-KPI Monthly Reports and the service definition and user guide 'pack' provided to Actors/Users). The

table below is an extract from Appendix C, highlighting contracted, actual and suggested response times for future services:

#	Name	Dom/ Non-Dom	SLA/ KPI		
			Required	Delivered (Average)	Suggested (Interactive Invocation)
1	Request Unique Property Reference Number (New)	Non-Dom	<24h	tbd	<24h
2	Request Unique Property Reference Number (Lookup Existing)	Non-Dom	<30s	<2s	<5s
3	Lookup Property Unique Property Reference Number	Dom	<1m	<3s	<5s
4	Validate Property Unique Property Reference Number	Non-Dom	<30s	<0.06s	<10s
5	Validate Property Unique Property Reference Number	Dom	<1m	0.02s	<10s
6	Add new address details to the EPC Register	Non-Dom	<24h	<4h	<4h
7	Add new address details to the EPC Register, once information has been received	Dom	<24h	<4h	<4h
8	Address Matching Service (aka. o Landmark Address Matching Services via SOAP)	Non-Dom			<10s
9	Submit and lodge Energy Documents and Model Data (aka. Secure Lodgment)	Non-Dom	<1m (06:00-24:00); Before 09:00 (00:00-09:00)	<8s	<30s
10	EPC Lodgement	Dom	<2m	<1s	<30s
11	Change in status of Energy Documents and Model Data (aka. Report Status Change)	Non-Dom	<1m	tbd	<10s
12	Change EPC Status	Dom	<12h	tbd	<10s
13	Retrieve and view Energy Documents & Model Data (aka. Report Retrieval; o DCLG Non Domestic EPC Requests via SOAP)	Non-Dom	<30s	<0.7s	<30s
14	Retrieve EPC (Public facing service) (aka. EPC Requests Via REST)	Dom	<1m	<0.8s	<30s
15	Lookup of Energy Assessor (aka. Energy Assessor Register; Energy Assessor Validity Check)	Non-Dom	<15s	<0.2s	<10s
16	Search Energy Assessor Register Index (aka. Energy Assessor Validity Check)	Dom	<1m	<0.3s	<10s
17	Update Energy Assessor Index	Non-Dom	Before 'Next Day' (in Service Spec); <1m in SLA/KPI Sheet	<0.007s	<30s
18	Update Consolidated Energy Assessor Register	Dom	<8h	<0.006s	<30s
19	Produce regular data extracts and reporting to DCLG	Non-Dom	none	tbd	
20	Central Information Point (CIBSE Benchmark Tables, Degree Days Data, CO_2 Emission Factors, Area Conversion Factors, Energy improvement Measures)	Non-Dom	<30s	<0.3s	<30s
21	High Level Lodgement Statistics	Non-Dom			
22	High Level Lodgement Statistics	Dom			
23	Accreditation Scheme annual reports	Dom			

MHCLG should note that establishing an appropriate set of response time targets would require further detailed user focused research, in step with GDS and industry practices, into the use cases for the services and the circumstances under which services are being invoked.

The SLA-KPI reporting process has interpreted the Performance and Response time targets as applying at the boundary of the core Application system (i.e. rather than as experienced by the Actor/User).

[**Recommendation #17:** MHCLG should specify and require measurement of performance and response time at the core Application boundary and as experienced by the Actor/User.]

Delivery of future services via an 'as a Service' model provides the opportunity to provision linear scalability both up and down (e.g. as rate of use of EPC Model Data increases or the regulatory requirement for EPCs is removed).

[**Recommendation #18:** MHCLG should specify and require linear scalability up and down from the aaS Service Provider for all system resources required to deliver the service (e.g. CPU, RAM, Network, Persistent Storage) performance, response and capacity requirements.]

[**Recommendation #19:** MHCLG should ensure that future 'data loss' requirements are articulated in industry-standard form in terms of 'recovery point objectives' with greater differentiation (e.g. more specific about particular data sets).]

[**Recommendation #20:** MHCLG should ensure that future contracts mandate industry-standard level of maturity in capacity planning and management, and that MHCLG is able to service the service provider with appropriate projections (e.g. #users, transaction rates, access patterns)]

[**Recommendation #21:** MHCLG should completely review and re-specify all NFRs and Service Levels before re-procuring and drive these from specific Business Service requirements as it is likely that bidders will only cost their service to meet (rather than exceed) them.]

[**Recommendation #22:** MHCLG should ensure that the next contract(s) put in place ensure that the service provider is incentivised to avoid charging MHCLG for over-provisioning.]

[**Recommendation #23:** As provisioning of Technical Capability is normally done in 'units' of availability and MHCLG will want to leverage the benefits of procuring the standard (i.e. 'off-the-shelf' offerings of service providers, MHCLG should identify approximate or range (i.e. lowest tolerable-ideal) Service Levels for Performance/Response, Availability and Scalability.]

7.2. Technical Design Requirements and Constraints

The purpose of this section is to recommend additional technical design considerations to ensure the service can be managed appropriately and is able to adapt to changing policy requirements. This is focused specifically on the Service Management & Operations aspects. Technical Design will be considered to the point that is relevant for procurement of SaaS & PaaS (e.g. Service Integration, Interfaces).

Subject areas covered by this section include:

- **Service Model** – covering resource ownership, consumption & management (i.e. 'Cloud/as a Service' vs owned assets)
- **Adaptability & Extensibility** – of the persistent data model, business logic, user interface, digital interfaces (data exchange models & process logic)
- **Portability** – of the data and business logic. This is especially significant when consuming 'as a Service' to ensure availability of provider choice into the future
- **Security, Access Control & Regulatory Compliance** – covering issues of privileged and authorised access to business logic and data & demonstrable (i.e. evidenced) meeting of all relevant regulatory requirements (e.g. GDPR). [Note – covered if time permits]

7.2.1. Service Model

The Requirements for this engagement, GDS guidance/requirements and market trends strongly suggest that evolution of the current solution and re-procurement (and re-implementation) of the 'next generation' service will need to be based on Cloud (a.k.a. 'as a Service' or 'aaS'). It is highly unlikely that a cost-effective and sustainable approach to deployment of the next generation of EPBR services would involve MHCLG owning assets to the degree it does today.

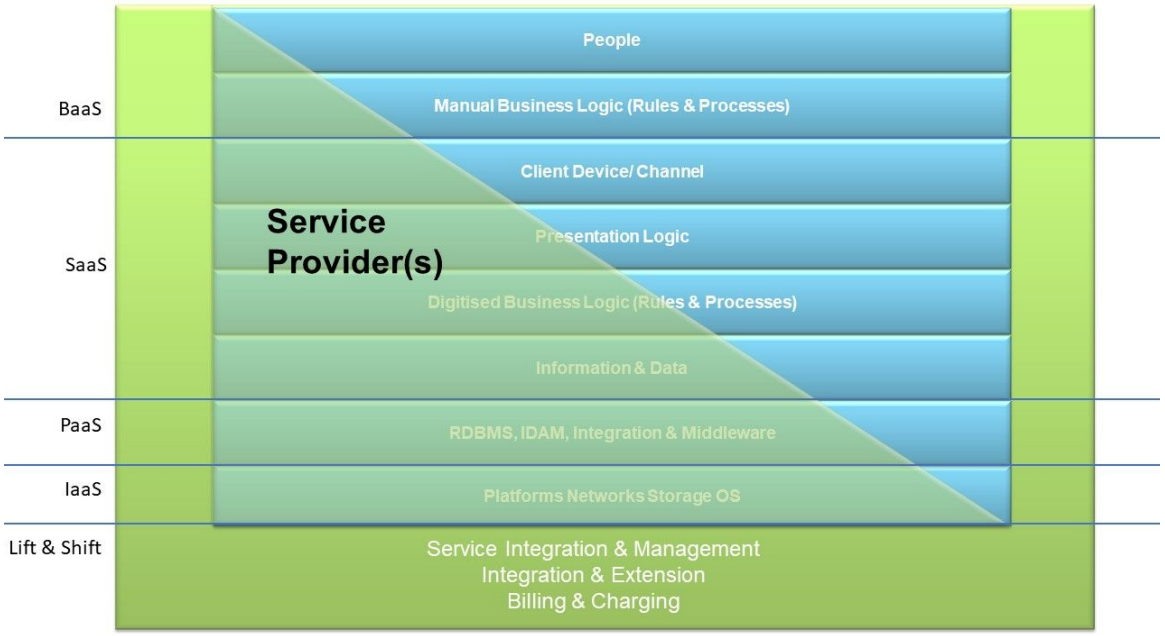
The current solution has taken a significant step towards enabling aaS service models by adopting a 'Business Process Outsourcing' model for system lifecycle management (e.g. stakeholder management & development), Service Management & Support. However, MHCLGs ownership of the Technical Capability assets has created a situation where the service provider takes little or no risk & what risk it does take is mitigated through the MHCLG-funded purchase of excess capability.

The key feature shared by all 'as a Service' models is that the service provider owns and manages all assets required to deliver the service – this includes Technical and non-Technical capabilities and involves managing the life-cycle of assets, dealing with technological obsolescence and refresh, supplier management and all security, privacy and regulatory requirements. The customer or client places service requirements on the provider that are agnostic of the solutions deployed to deliver them.

The primary 'aaS' service models are well articulated in open source material (e.g. https://en.wikipedia.org/wiki/Cloud_computing#Service_models), but to summarise:

- **Infrastructure as a Service (IaaS)** - online services that provide high-level APIs used to decouple Application and Platform software from the various low-level details of underlying network infrastructure like physical computing resources, location, data partitioning, scaling, security, backup etc
- **Platform as a Service (PaaS)** – similar to IaaS in principle, but further up the Architecture stack, providing capabilities enabling the consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages, libraries, services, and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly configuration settings for the application-hosting environment (NIST Definition).
- **Software as a Service (SaaS)** – similar to PaaS in principle, but even further up the Architecture stack, providing capabilities enabling the consumer is to use the provider's applications running on Platforms and Infrastructure of their choice. Applications are accessible from various client devices through either a thin client interface, such as a web browser (e.g., web-based email), or a program interface. The consumer does not manage or control the underlying Application Software, Platform or Infrastructure resources. (NIST Definition)
- **Business as a Service (BaaS)** – typically associated with Business Process Outsourcing. This model comprises a total outsource of a business operation including People, Process, Technology and Facilities.

The following graphic illustrates the differentiation between these Cloud Models and the options for positioning and contracting with Service Providers:



Implications and Options

Combining the existing service model for EPBR with the 'as a Service' models, MHCLG can treat the following options as end points in themselves or transition points on a roadmap. They are listed are in transition sequence (note that as with all transition sequences involving aaS, there is a lot of repetition in the description of the service/solution as the principles are similar & the differentiation focused on where in the Architecture stack the provider/consumer boundary lies).

1. **Lift & shift** (the equivalent of the 'Migration' option in the section on *Transition Considerations*) - all existing assets and install into a new environment – where the 'environment' provides all capabilities that currently exist but that are not owned by MHCLG. As detailed in T*ransition Considerations*, examples of such capabilities include: facilities, development life-cycle (people, process and technology) & Service Management (e.g. monitoring, reporting, support/help, housekeeping – examples include JIRA, PRTG, Sys Admin Tools & Scripts, JENKINS).

   Note that this is the simplest and lowest risk option that involves a change of service provider but still incurs significant one-off costs and risks that would typically need to be spread over a minimum of a 3-year commitment to be attractive to bidders and be a cost-effective approach that spreads the costs of transition in and out. MHCLG should aim to transfer most assets under this option and delegate decisions to refresh/upgrade/redeploy assets to deliver on Service Levels and NFRs (note that these will need significant review and rework to be acceptable to stakeholders and users).

2. **IaaS + Application & Platform Development & Maintenance + Service Management** – removes the need for MHCLG to be focused on the Infrastructure Platform. While the IaaS provider should be expected to provide migration services, a separate provider could be considered for Application & Platform Software development & maintenance that specialises in those capabilities/disciplines. MHCLG could consider procuring and commissioning Service Management independently to cover the overall EPBR service (including Applications Software, Level 1 support), potentially as part of (or at least integrated with) similar services that cover other MHCLG systems & services – a typical SIAM capability.

3. **PaaS + Application Development & Maintenance + Service Management** – this option is similar in principle to IaaS, additionally removing the need for MHCLG to be focused on the Application Software Platform as well as the underlying Infrastructure that supports it. Initially, as a significant amount of EPBR software is implemented in proprietary (e.g. Oracle) technology, available service providers would be constrained. This option enables MHCLG to retain the

controlling interest in the components of the system that are closest and most sensitive to business needs (i.e. the Application data and logic) while driving competition in price and service quality of Platform offerings.

As for IaaS, while the PaaS provider should be expected to provide migration services, a separate provider could be considered for Application Software development & maintenance. MHCLG should consider migration/re-implementation of software that depends on proprietary Platform features into the platform-independent application layer (e.g. stored procedures into Java) to increase the range and pricing of PaaS Service Providers. Also similar to IaaS, MHCLG could consider procuring and commissioning Service Management independently to cover the overall EPBR service (including Applications Software, Level 1 support), potentially as part of (or at least integrated with) similar services that cover other MHCLG systems & services – a typical SIAM capability. This Option should be considered the minimum target for procurement of the next generation of EPBR.

4. **SaaS + Service Management** – this option is similar in principle to PaaS, additionally removing the need for MHCLG to be focused on the Application Software as well as the underlying Platform and Infrastructure that supports it. Similar to PaaS, MHCLG could consider procuring and commissioning Service Management independently to cover the overall EPBR service (including Level 1 support), potentially as part of (or at least integrated with) similar services that cover other MHCLG systems & services – a typical SIAM capability.

   Note that delivery through a SaaS model could be achieved either by finding a provider willing to take ownership of the Application Software that exists, or by migrating to and configuring the providers' own Application Software. While there are likely to be generic 'Certificate & Accreditation Management' off-the-shelf services and products, it is unlikely that the economic case could be made for this approach in the absence of clear, specific, and funded requirements for change & enhancement.

5. **BaaS** – this option is similar in principle to PaaS, additionally removing the need for MHCLG to be focused on the Application Software as well as the underlying Platform and Infrastructure that supports it. Similar to PaaS, MHCLG could consider procuring and commissioning Service Management independently to cover the overall EPBR service (including Level 1 support), potentially as part of (or at least integrated with) similar services that cover other MHCLG systems & services – a typical SIAM capability.

Note that delivery through a SaaS model could be achieved either by finding a provider willing to take ownership of the Application Software that exists, or by migrating to and configuring the providers' own Application Software. While there are likely to be generic 'Certificate & Accreditation Management' off-the-shelf services and products, it is unlikely that the economic case could be made for this approach in the absence of clear, specific, and funded requirements for change & enhancement.

MHCLG should note that all the above Options, with the exception of Option #1 would require a significant uplift MHCLGs Procurement capability to enable the articulation of 'aaS' requirements to drive and constrain the service/solution appropriately. Changes will also be required to enable full exploitation of aaS pricing and charging models – e.g. to facilitate PAYG (Pay as You Go) for burst load conditions.

The nature of EPBR suggests that it is a good candidate for a full BaaS service model for the following reasons:

1. The vast majority of services are directly delivered to Actors & Users rather than via MHCLG.
2. The service generates revenue which can be used to finance the Technical and Service Capabilities needed to deliver the service.
3. MHCLG itself does not make significant use of the data acquired by the system

[**Recommendation #24:** MHCLG should either target Platform as a Service (PaaS) or Business as a Service (BaaS) as the most appropriate models for the next generation of EPBR.]

[**Recommendation #25:** Given also that EPBR is almost a standalone service, MHCLG should look for a 'one-stop-shop' to deliver an integrated bundle of services.]

7.2.2. Adaptability & Extensibility

The current EPBR system approach to interfaces has generally been architected to use industry-standard practice for adaptability & extensibility. Specifically, the use of defined interface specifications, secure SOAP and REST-implemented Web Services, WADL, WSDL and XML/XSD Schemas. MHCLG should note that industry-standard in this case, means the use of common technology and that this does not imply anything about the quality of the interfaces (e.g. XML only covers syntax and structure, not integrity and semantics). However, they have been in operation for a significant time and can be considered tried and tested operationally as well as in the context of 3rd party software development.

Interfaces are currently supported for:

- Address Matching
- Secure Lodgment
- Report Status Change
- Report Retrieval
- Energy Assessor Register Maintenance
- System/Software Development (e.g. by Schemes and software vendors), including the Central Information Point.

Change to and extension of any interfaces or internal business logic or data is invariably a development-cycle activity, requiring full life-cycle development to implement. This should be expected for software that is 100% bespoke for a specific purpose for a specific customer as there is little incentive to architect the software to be configurable for different purposes or customers.

[**Recommendation #26:** The current approach to interface management should continue into future EPBR implementations and the opportunity taken to use Web service versioning that is tolerant to multiple concurrent use of different versions of the same interface.]

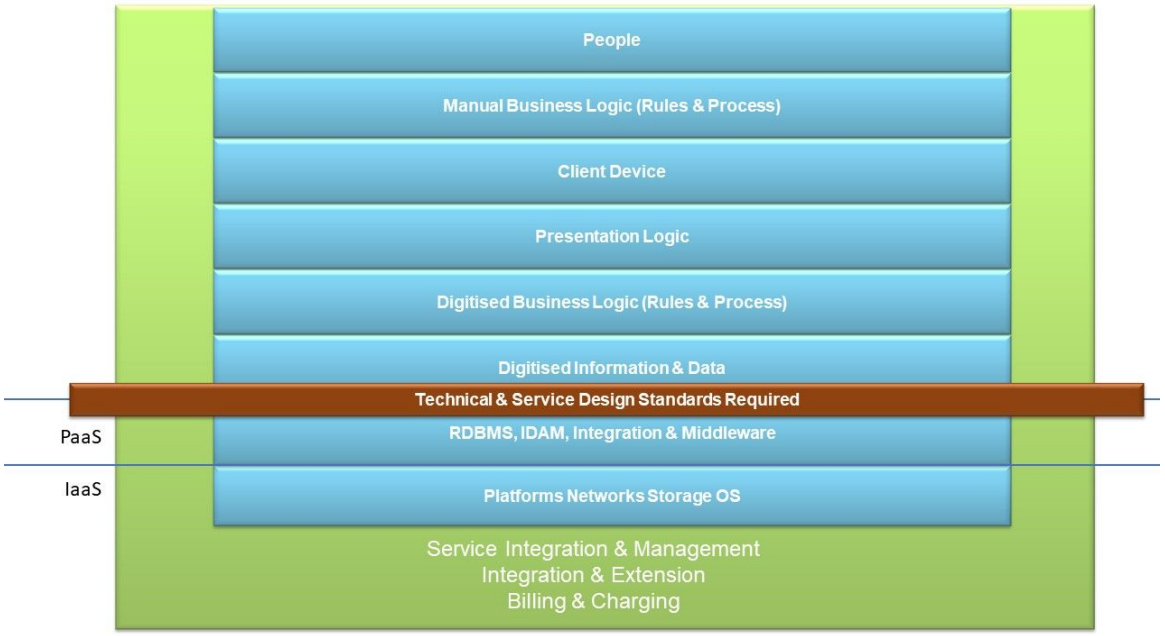
Internal EPBR business logic and data architecture is hard coded. This means that no specific measures have been taken in terms of software architecture to promote extensibility and adaptability. Special measures are unlikely to be cost-effective in this environment as the system is special-purpose and for a specific customer. Such special measures would be appropriate where multiple customers and/or multiple contexts needed to be catered for while ensuring coherence and exploiting opportunities for re-use. It is highly unlikely that re-engineering the existing system to enhance its configurability would be cost-effective.

As MHCLG adopts an aaS service model, any such special measures are only of concern to the service provider, as the benefits of implementing for time/cost/risk/impact to deployment of change are experienced by MHCLG in the parametric pricing & timescales model associated with service & system change. As observed in previous sections, for EPBR, the time taken to manage change through the system is more significantly influenced by the timescale of regulatory change and stakeholder engagement than software change. This means that Technical Standards are not necessary or appropriate to manage extensibility and adaptability other than already covered by Interfaces and Portability.

7.2.3. Portability

Technical Design Standards are required at all points at which the service provider's solution interacts with MHCLG or EPBR stakeholders. MHCLG should note that the specifications needed will depend greatly on the aaS service model selected. This section assumes that a PaaS service is selected (see graphic below) and that MHCLG procures a separate managed service for Software Development.

Requirements (e.g. Technical & Service Design Standards) will be needed at the points that MHCLG interacts with the Service Provider or its chosen environments (e.g. Client Device). Typically, these cover operational integration and standards to ensure portability of MHCLG assets (e.g. data, application software) on exit from the contract. The graphic and recommendations below assume a PaaS arrangement:



[**Recommendation #27:** If PaaS is the preferred arrangement, MHCLG should define, adopt or agree specific and contractually verifiable Technical and Service Management Design Standards and Constraints covering:

- **Recommendation #27.1: Operational (i.e. runtime) Platform interfaces** – these are all the APIs and similar that define how the Application Software interacts with the underlying Platform services. Typically involving RDBMS (e.g. SQL or subsets of, technology-agnostic Table schemas), Identity and Access Management (e.g. for authentication & authorisation)
- **Recommendation #27.2: Service Integration & Management Interfaces**: covering all People, Process and Technological capabilities needed for MHCLG to supervise the Service (e.g. SLA/KPI Reporting, Provisioning & Incident Management, Capacity Management, Service/System Monitoring, SNMP agents). MHCLG should anticipate that this interface should be 'plug-compatible' with the concept of SIAM (Service Integration and Management) whether in or out-sourced.
- **Recommendation #27.3: Operational Application Layer Interfaces** – covering Application-to-Application Interfaces see the earlier recommendation above [ref #nnn] to continue with existing practice and enhance.
- **Recommendation #27.4: Life-cycle and Change Management:** this includes requirements, architecture, design, code, test etc. Note that this does not apply to the PaaS provider, only to the provider of the managed service for Software development. Typically this would include interoperability of models (e.g. through the use of BPMN, XMI-based model repositories, self-describing software (e.g. WSDL), non-proprietary Data Models) and software & configuration repository content.
- **Recommendation #27.5: Service Transition:** including migration to and migration from the procured service. These are typically the standards and constraints that enable the migration of Operational business data and metadata between successive service providers.

MHCLG should note that delivery of greatest value-for-money depends on leveraging as far as possible the off-the-shelf service offered by service providers in the marketplace. It will therefore need to avoid over-prescription and use the procurement process to evolve such standards & constraints iteratively with bidders (e.g. through a competitive dialogue)]

7.2.4. Government Digital Services (GDS)

GDS provides a wealth of online advice and guidance, some of which is relevant to EBPR and of value. However:

- Much of it focuses on the process by which services are conceived of, designed, built and operated (not the focus of this assessment).

- There is significant ambiguity in the guidance, which can not be easily translated into requirements in advance of specifying, procuring or designing a service. The GDS model is one of evaluating proposed services, requiring rework and iterating.
- Is not up to date with the current market trends and offerings
- Much of it assumes the systems are developed and maintained in-house under the supervision of the Government client organisation. Move to 'as a Service' provision removes the need for such guidance and constraint.

No specific recommendations are made as part of this Assessment, however analysis highlights specific areas of interest (excluding process guidance) to the re-procurement of EPBR are likely to be limited to (titles cut & pasted from GDS web content):

1. **Digital Service Standard:**
    - **Monitoring the status of your service:** this is a very relevant topic, but would need a lot of work to make specific enough to incorporate into a procurement process/contract for the following reasons:
    - Much can be left to the Service Provider as an 'internal' check
    - SLAs/Service Level Requirements/Service Qualities will be needed provide the specific targets and thresholds
    - Additional requirements would be needed to specify alerts, mechanisms, SIAM integration etc
    - **Open standards that all of government must use**: while there may be some that are relevant (e.g. 'Exchange of Location Point', 'Date-times and Time-Stamps', 'Persistent Resolvable Identifiers' (e.g. for UPRN)), the 'standards' itemised are very limited in coverage & value.
    - **Collect Performance Data:** while a relevant topic, much of this guidance assumes in-house service provision. Given that 'as a Service' is the preferred option, much can be delegated to the service provider.
    - **Identify Performance Indicators & Report performance data on the Performance Platform:** most of the topics covered here assume the initiative is to move users to the 'digital/online channel' as EPBR is all about digital submissions and interaction, it is not particularly relevant. MHCLG will, however, need to define KPIs in association with SLAs etc.
    - **Choosing Technology:** unlikely to be significant - mainly about Technology Selection Process. With a shift to 'aaS' (incl 'Cloud First'), Technology Selection will have reduced significance.

2. **Service Manual:**
    - **Data you must measure and report:** most of these are relevant, with the exception of 'digital take-up' (although 'cost per transaction' should be just built in to the commercial agreement and rolled up into 'cost of service' - unless it's a transaction-based/PAYG pricing model.).
    - **Building your service: the frontend:** this Will be relevant during re-implementation of User interfaces (e.g. EBPR Web Portal refresh).
    - **Integrating with external software and data:** good advice, however MHCLG should treat as guidance only as 3rd parties may have their own (and potentially more recent and suitable) means.
    - **Hosting Your Service:** very relevant (e.g. SaaS, PaaS, IaaS), but not prescriptive. GOV.UK PaaS should be an option - but compete on cost/effective grounds alongside other providers.
    - **Protecting User Information:** highly relevant, especially if EPC information is shared more widely and not for the original purpose it was collected for.

3. **Technology Code of Practice:**
    - **Make things accessible:** highly relevant – to be included in re-procurement
    - **Be open and use open source:** MHCLG should be able to show that this has been considered, but does not directly rely on Open Source as it would then require an in-house capability to manage it. A more likely outcome is use of Open Source as an embedded part of a 3rd party SaaS, PaaS, IaaS offering.

- **Make use of open standards:** this is relevant, however MHCLG will need to be much more specific and/or the bidders propose the open standards they suggest.
- **Use cloud first:** highly relevant, but not specific. While market forces and value for money are the main drivers for MHCLG to adopt 'as a Service' models, they are als consistent with 'cloud first' guidance. Crown Hosting Data Centre should be considered if it exists and is fit for purpose, but compete with 3rd parties.
- **Make things secure: h**ighly relevant. Bidders should be invited to articulate how they will meet these requirements and what the cost is sensitive to.
- **Make privacy integral: Highly relevant.** Bidders should be invited to articulate how they will meet these requirements and what the cost is sensitive to.
- **Share and reuse technology: r**elevant, however MHCLG should delegate to 3rd party provider and judge the benefits by the pricing. 'Share & re-use' presumes in-house development which is not a preferred acquisition/provisioning option.
- **Integrate and adapt technology:** useful, but becomes less relevant the more 'aaS' is procured as it assumes in-house creation of systems.

4. **Design and Style**: relevant for re-implementation of user interfaces

5. **Components:**
   - **GOV.UK Notify:** could be useful - but no need to constrain provider as they may have their own.
   - **GOV.UK Verify:** could be useful - but no need to constrain provider as they may have their own.
   - **GOV.UK Registers: c** ould offer up EPBR as a register, but current GDS registers are more about reference data rather than content. A definitive custodian of address/ location/ building data would be useful but would need negotiation with other organisations to agree ownership and responsibilities.
   - **GOV.UK Pay** :could be useful - but no need to constrain provider as they may have their own.
   - **GOV.UK Platform as a Service**: could be useful - but no need to constrain provider as they may have their own.

Appendix A - Source Materials

This appendix provides a catalogue of source materials utilised as inputs to the review, together with continual dialogue and clarifications with stakeholders listed as the beginning of this report.

Category	Document Name
Authority Review Requirements and Context:	Requirements Capture Workshops and Outcomes v2
	EPBR Overview for technical assessment
	GDS Meeting 28112017 v0.3.ppt
	GDS Service Design Standards, Manual and Technology Code of Practice
Service Specifications and Contractual:	Service requirement Specification -Non Dom contract schedule 2-2013
	Service Specification-Dom contract schedule 2-2013
	Service requirement Specification -Non Dom contract schedule 2-settlement

	Service Specification-Dom contract schedule 2-settlement 201
	Domestic EPC Register Exit Plan v0.4
	Non-Domestic EPC Register Exit Plan v0.4
Service Interface and Integration:	20180228_Domestic_EPC_Register_Services_v7.0.doc
	Green Deal Register Non-Domestic Disclosure Page Interface Service Specification v1.0.docx
	Green Deal Register Domestic Interface Service Specification v1.2.docx
	2 Green Deal Register Domestic Disclosure Page Interface Service Specification v1.1.docx
	20180228_Non_Domestic_EPC_Register_Services_v10.0.doc
System Architecture and Technology:	Registers Network Diagram v2.2_unclassified_version.pdf
	EPC-High Level Software Architecture v1
	Copy of Registers Virtual Machines.xlsx
	Domestic England Wales {EPC} Registers Stack Architecture 0.3.vsd
	Domestic Green Deal {DGD} Registers Stack Architecture 0.3.vsd
	Shredder Loader Stack Architecture 0.1.vsd
	Non Domestic England Wales {NDEPC} Registers Stack Architecture 0.3.vsd
	Non Domestic Green Deal {NDGD} Registers Stack Architecture 0.4.vsd
	Non Domestic Northern Ireland {NINDEPC} Registers Stack Architecture 0.3.vsd
	Domestic Northern Ireland (NIDEP) Registers Stack Architecture 0.3.vsd
Processes:	Change Management Process V1.0.docx
	Solutions Agile Development Model v1.0
	20090515 High Level BPM Issue v1.2.doc
	20110325 High Level BPM Non Dwellings v1.01.doc
	EPC Service Desk User Guide V2 280218
	DCLG Process Flows Asset Management v1.3.pdf
	Solutions Release Management Process v1.0
Service Reports:	17 09 - (to mid sept) DCLG SLA-KPI Report 13th August - 9th September 2017
	17 10 - (to mid Oct) DCLG SLA-KPI Report 10th September - 7th October 2017
	17 11 - (to early Nov) DCLG SLA-KPI Report 8th October - 4th November 2017
	17 12 - (to early Dec) DCLG SLA-KPI Report 5th November - 2nd December 2017
	18 01 - (to end Dec) DCLG SLA-KPI Report 3rd December - 30th December 2017
	18 02 - (to end Jan 18) DCLG SLA-KPI Report 31st December - 27th January 2018
	BO E&W DW Report Listing.xlsx

Asset Registers:	150531 DCLG_Fixed_Asset_Register_Hardware_20150531_v1
	150531 DCLG_Fixed_Asset_Register_Software_20150531_v1
	Registers Estate v4.17.xlsx.
	Registers Estate v4.17_Traffic_Light.xlsx
Data Models and Schemas:	LIG-CEPC-7.1.zip
	LIG-CEPC-7.1-NI.zip
	Domestic Register - ERD
	RdSAP-Schema-LIG-18.0.zip
	RdSAP-Schema-LIG-NI-18.0.zip
	SAP-Schema-LIG-17.1.zip
	SAP-Schema-LIG-NI-17.4.zip
	EXDWPRD - ERD.html
	EXDWPRD - ERD_0x0.png
	EXDWPRD - ERD_0x1.png
	EXDWPRD - ERD_0x2.png
	EXDWPRD - ERD_1x0.png
	EXDWPRD - ERD_1x1.png
	EXDWPRD - ERD_1x2.png

Appendix B - Recommendations Catalogue

The following table is a consolidated list of Recommendations included in the main body of this document.

#	Title/ Short Description	Further Detail
1	MHCLG should recognise that the current conditions do not lend themselves to driving sufficient interest in the marketplace to ensure real competition or a compelling business case for re-implementing the existing system capabilities.	For example: data, business logic, user interface. In the absence of clear, specific, certain and funded requirements for change/enhancement, competition will be limited to the costs of running the service based on the existing system, combined with an ongoing refresh of system components as necessary to maintain service quality and security. This means that re-procurement on the basis of SaaS should be deferred until suitable conditions exist. Procurement on the basis of Lift & Shift, IaaS and PaaS should include a provision for parametric pricing that MHCLG can then test against a standard set of internal assumptions during the

		competition and that are contractually binding for the duration of the contract. MHCLG should note that use of parametric pricing will require suitable MHCLG internal capability to manage (e.g. agreeing parameters and challenging proposed pricing in response to chance requests)
2	MHCLG should closely monitor and influence the specification of requirements on EPBR, noting that this means a significant degree of 'solutioning' in response to emerging requirements in order to optimise decisions	For example: whether requirements are met by creating another system and integrating versus changing EPBR.)
3	MHCLG Bidders should be asked to propose a parametric pricing model for such changes that MHCLG can then test against a standard set of internal assumptions	
4	MHCLG should define a set of detailed Architectural Standards that promote flexibility in each of these impact areas that do not require significant investment to deliver	Note that these will have a lot in common with the content of 'Technical Design Requirements & Constraints'
5	MHCLG should define a set of assumptions for each policy areas and ensure bidders are asked for detail on how they will cater for them.	
6	MHCLG should define a set of assumptions for each of these policy areas and ensure bidders are asked for detail on how they will cater for them. EPBD3 assumptions should be based on early sight of the text and/or intelligence	
7	MHCLG should anticipate the opportunity/requirement to significantly extend the EPBR data model (including capture & access) to record additional attributes of the buildings covered	For example: materials, risk, other forms of certification. Bidders should be asked to propose a parametric pricing model for such changes that MHCLG can then test against a standard set of internal assumptions
8	Given the timing (and uncertainty of timing) of the Grenfell review, MHCLG should set expectations with UK Government that any resulting changes to the EPBR System and Service will not be made to the existing estate	
9	MHCLG should anticipate the requirement to marginally extend the EPBR data model (including capture & access) to record additional attributes to enable improved SAP and homebuying processes	It should also anticipate requirements to marginally change business logic (e.g. business rules, process, data validation). Bidders should be asked to propose a parametric pricing model for such changes that MHCLG can then test against a standard set of internal assumptions
10	MHCLG should assume that changes to the Data Model will be limited to minor	These may involve development of interfaces (and the system capabilities to service them) to

	extensions required to provide coherent cross-referencing and linking to other external data. It should also assume that additional and potentially granular access will be required to EPBR data	provide controlled access to summarised and statistical information as well as platform-independent bulk extraction of granular data. MHCLG should ensure appropriate stakeholders recognise its assumption that access to granular bulk data is only provided without commitment to maintaining the database schema as a published interface & that the using/receiving system/service will need to manage its own transformation rules & capabilities. Bidders should be asked to propose a parametric pricing model for such changes that MHCLG can then test against a standard set of internal assumptions.
11	MHCLG should take an early view on emerging Smart Meter standards and the implications of converging with EPC interchange standards	
12	MHCLG should assume that any technical solutions in the area of Self-Assessment are independent of the EPBR that deals with assured certificates	
13	MHCLG should minimise further investment in the existing EPBR service/system to that absolutely necessary to provide an acceptable level of technical and business continuity	When requirements acquire certainty, they can be fed into a managed change process and evaluated for cost/benefit, given the expected ROI period (i.e. lifetime of the system) at the time. If certainty (and clarity) emerges prior to inviting service providers (current or future) to respond to the MHCLG requirements, the emerging requirements should be included in the procurement for the next generation EPBR
14	MHCLG should avoid significant change to the Technical Capability to tune Service Levels during the LIG contract extension period. The benefits of making the changes would probably not outweigh the risks to performance and business continuity during the contract extension.	
15	MHCLG should only implement changes arising from technological obsolescence if the risks (e.g. to availability of failing components) can not be mitigated by the excess capacity present	
16	As part of the LIG contract extension negotiation, MHCLG should request LIG to identify precise costs and risk (mainly availability/resilience and response times) impact of reducing the level of 3rd party support procured from technology vendors (software and hardware)	
17	MHCLG should specify and require measurement of performance and response time at the core Application	While MHCLG has no control over the Actor/User devices or network, the Actor/User experience is the aggregate measure that is significant for

	boundary and as experienced by the Actor/User	MHCLG. Architecture tradeoff decisions (e.g. 'thickness' of client) will be influenced by this measure.
18	MHCLG should specify and require linear scalability up and down from the aaS Service Provider for all system resources required to deliver the service (e.g. CPU, RAM, Network, Persistent Storage) performance, response and capacity requirements	Commercial arrangements should ensure that provision is made for a predictable core/constant degree of load, 'burst' load (e.g. for infrequent peaks) and trending loads (while MHCLG determines whether the new load is sustained and can be procured as 'core'). Each of these should be priced independently, with price thresholds clearly specified.
19	MHCLG should ensure that future 'data loss' requirements are articulated in industry-standard form in terms of 'recovery point objectives' with greater differentiation (e.g. more specific about particular data sets).	Combined with procurement and technical delivery 'as a Service', this will enable the service provider to optimise the solution to be adequate but cost no more than necessary.
20	[Recommendation #20: MHCLG should ensure that future contracts mandate industry-standard level of maturity in capacity planning and that MHCLG is able to service the service provider with appropriate projections (e.g. #users, transaction rates, access patterns)]	
21	MHCLG should completely review and re-specify all NFRs and Service Levels before re-procuring and drive these from specific Business Service requirements as it is likely that bidders will only cost their service to meet (rather than exceed) them.	Re-procuring with the existing defined Service Requirements will almost certainly result in procurement of a significantly reduced level of service.
22	MHCLG should ensure that the next contract(s) put in place ensure that the service provider is incentivised to avoid charging MHCLG for over-provisioning.	This could take the form of Infrastructure and Platform 'as a Service' arrangements that delegate the technical design and capacity to the provider at their cost while ensuring they can be held to account for service levels experienced.
23	As provisioning of Technical Capability is normally done in 'units' of availability and MHCLG will want to leverage the benefits of procuring the standard (i.e. 'off-the-shelf' offerings of service providers, MHCLG should identify approximate or range (i.e. lowest tolerable-ideal) Service Levels for Performance/Response, Availability and Scalability	Bidders should then be invited to participate in an iterative process to refine and finalise requirements that recognises their price/performance point thresholds (e.g. cost-effectiveness of procuring 'Gold' rather than 'Silver' level of service
24	MHCLG should either target Platform as a Service (PaaS) or Business as a Service (BaaS) as the most appropriate models for the next generation of EPBR	It should note that the BaaS model would probably need to be accompanied by a shift in responsibility to the Service Provider to set fees for Service use. The BaaS Service Provider would probably also require some guarantees on transaction volumes (e.g. lodgements) to enter into meaningful commercial arrangements that

		are self-funding and self-managing.
25	Given also that EPBR is almost a standalone service, MHCLG should look for a 'one-stop-shop' to deliver an integrated bundle of services.	While there are potential economies of scale associated with acquiring service providers that specialise in components of the EBPS service/solution (specifically Platform, Application Development & Maintenance, Service Management & Delivery), it is unlikely that MHCLG are or will be in a position to exploit them.
26	The current approach to interface management should continue into future EPBR implementations and the opportunity taken to use Web service versioning that is tolerant to multiple concurrent use of different versions of the same interface.	This avoids the need for the current 'big bang' approach to cutover when changes are made
27	TMHCLG should define, adopt or agree specific and contractually verifiable Technical and Service Management Design Standards and Constraints covering:	MHCLG should note that delivery of greatest value-for-money depends on leveraging as far as possible the off-the-shelf service offered by service providers in the marketplace. It will therefore need to avoid over-prescription and use the procurement process to evolve such standards & constraints iteratively with bidders (e.g. through a competitive dialogue)
27.1	Operational (i.e. runtime) Platform interfaces	These are all the APIs and similar that define how the Application Software interacts with the underlying Platform services. Typically involving RDBMS (e.g. SQL or subsets of, technology-agnostic Table schemas), Identity and Access Management (e.g. for authentication & authorisation
27.2	Service Integration & Management Interfaces	Covering all People, Process and Technological capabilities needed for MHCLG to supervise the Service (e.g. SLA/KPI Reporting, Provisioning & Incident Management, Capacity Management, Service/System Monitoring, SNMP agents). MHCLG should anticipate that this interface should be 'plug-compatible' with the concept of SIAM (Service Integration and Management) whether in or out-sourced
27.3	Operational Application Layer Interfaces	Covering Application-to-Application Interfaces see the earlier recommendation above [ref #nnn] to continue with existing practice and enhance
27.4	Life-cycle and Change Management	This includes requirements, architecture, design, code, test etc. Note that this does not apply to the PaaS provider, only to the provider of the managed service for Software development. Typically this would include interoperability of models (e.g. through the use of BPMN, XMI-based model repositories, self-describing software (e.g. WSDL), non-proprietary Data Models) and software & configuration repository content.

27.5	Service Transition	Including migration to and migration from the procured service. These are typically the standards and constraints that enable the migration of Operational business data and metadata between successive service providers.

Appendix C - Change Items from Stakeholder Consultation

The following table is a consolidated list of items that may drive change to the EPBR system & service. This has been synthesized from a variety of sources and conversations.

#	Change Item/Driver
1	Functional Capability
2	Batch lodgements
3	Audit and quality assurance capabilities
4	Information Capability & Capacity
5	EPC Data Utilisation
6	Use of data for client advisory purposes
7	Data Quality Improvement
8	Data Quality Management Capabilities
9	Data & Content-Richness
10	Extensions - Entity/Attribute
11	Precision, Differentiation & Codification
12	Related Documents
13	Address Improvements
14	Industry Standard Data Model - Address
15	Address Associations
16	Address Accuracy
17	Postcode Search
18	Postcode Verification - Map
19	Address Validation
20	Commercial Address Format
21	Address Management Capabilities
22	Enhance address handling
23	New Build Unique Identification
24	Interoperability, Integration & Access
25	Greater access to open data and usage to improve properties
26	Full data sets to be available via XML
27	UPRN Standardisation
28	UPRN/Land Registry Mapping
29	Digital Economy Access
30	Extended Use
31	Interfaces to 3rd party stakeholders
32	Enhance data exploitation capability
33	Platform & Infrastructure Architecture
34	Technical Refresh (Web Portal)

35	Service Levels & Qualities
36	Disaster recovery
37	Service Management & Operations
38	To support Register users and resolve/escalate faults/issues from Helpdesk
39	Helpdesk service to resolve issues to be improved.
40	Managed Security
41	Technical support services
42	Life-cycle Management
43	Speed to IT Update
44	Test Environment Improvement
45	Development, test
46	Management of industry Technical Steering Groups (TSGs) & Conventions
47	Client management services
48	Domain/Community Covered
49	Wales
50	User Interface
51	User interface (style, use of terminology)
52	Language Support
53	Welsh
54	Irish
55	Navigation
56	EPC Web-portal to signpost additional services from assessors
57	Finding Assessors to be made easier
58	Assessor unique ID
59	Search Without URPN
60	Search by Business Name
61	Business Names on EPCs
62	Finding EPCs
63	Redesign user interfaces
64	Policy Changes
65	ECO
66	Green Deal
67	Private Rented Sector
68	Renewable Heat Incentive
69	Feed In Tariff
70	Fuel Poverty
71	Clean Growth Strategy
72	Clean Growth Strategy
73	Digital Land
74	Brexit-related & EPBD3
75	Climate Change Act
76	Green Mortgages
77	Policy Assumptions
78	Building Regulations (Fire & Safety)
79	SAP Review
80	Market & PESTLE Themes & Drivers

81	Home Buying Process
82	Accelerated Housebuilding
83	Stamp Duty Changes
84	Digital Economy Act
85	Smart Meters
86	Self-Assessment
87	Private Sector Initiatives
88	General Election
89	GDPR
90	Standards
91	Digital Service Standard
92	6. Evaluate Tools and Systems
93	Monitoring the status of your service
94	7. Understand Security and Privacy Issues
95	Information security
96	Cloud security
97	User accounts and logins
98	9. Use open standards and common platforms
99	Working with open standards
100	Open standards that all of government must use
101	15. Collect Performance Data
102	16. Identify Performance Indicators
103	17. Report performance data on the Performance Platform
104	Choosing Technology
105	Service Manual
106	Measuring Success
107	Data you must measure and report
108	Design
109	Technology
110	Choosing technology: an introduction
111	Building your service: the frontend
112	Managing a live service
113	Integrating with external software and data
114	Hosting Your Service
115	Protecting User Information
116	Technology Code of Practice
117	2. Make things accessible
118	3. Be open and use open source
119	4. Make use of open standards
120	5. Use cloud first
121	6. Make things secure
122	7. Make privacy integral
123	8. Share and reuse technology
124	9. Integrate and adapt technology
125	10. Make better use of data
126	Design and Style

127	Design Principles
128	Frontend Code
129	Style Guide
130	Design Patterns
131	GOV.UK Prototype Kit
132	Components
133	GOV.UK Notify
134	GOV.UK Verify
135	GOV.UK Registers
136	GOV.UK Pay
137	GOV.UK Platform as a Service
138	Monitoring
139	Performance Platform
140	Buying
141	Digital Marketplace

Appendix D - Service Performance & Response

#	Service/ Interface	Dom/ Non-Dom	Source			Invocation		SLA/ KPI/ Rqt		
			Schedule 2	20180228_Non_Domestic_EPC_Register_Services_v10.0	SLA-KPI Report	Inter-active	System/ API/ Program-matic	Required	Delivered (Average)	Suggested (for Interactive Invocation)
1	Request Unique Property Reference Number (New)	Non-Dom	Y			Y	Y	<24h	tbd	<24h
2	Request Unique Property Reference Number (Lookup Existing)	Non-Dom	Y			Y	Y	<30s	<2s	<5s
3	Lookup Property Unique Property Reference Number	Dom	n		Y	Y	tbd	<1m	<3s	<5s
4	Validate Property Unique Property Reference Number	Non-Dom	n		Y	tbd	tbd	<30s	<0.06s	<10s
5	Validate Property Unique Property Reference Number	Dom	n		Y	Y	tbd	<1m	0.02s	<10s
6	Add new address details to the EPC Register	Non-Dom	n		Y	tbd	tbd	<24h	<4h	<4h
7	Add new address details to the EPC Register, once information has been received	Dom	n		Y	tbd	tbd	<24h	<4h	<4h
8	Address Matching Service (aka. o Landmark Address Matching Services via SOAP)	Non-Dom	n	Y		Y	Y			<10s
9	Submit and lodge Energy Documents and Model Data (aka. Secure Lodgment)	Non-Dom	Y		Y	Y	Y	<1m	<8s	<30s
10	EPC Lodgment	Dom	n		Y	Y	tbd	<2m	<1s	<30s
11	Change in status of Energy Documents and Model Data (aka. Report Status Change)	Non-Dom	Y			n?	Y	<1m	tbd	<10s
12	Change EPC Status	Dom	n		Y	tbd	tbd	<12h	tbd	<10s
13	Retrieve and view Energy Documents & Model Data (aka. Report Retrieval; o DCLG Non Domestic EPC Requests via SOAP)	Non-Dom	Y	Y	Y	Y	Y	<30s	<0.7s	<30s
14	Retrieve EPC (Public facing service) (aka. EPC Requests Via REST)	Dom	n	Y	Y	Y	Y	<1m	<0.8s	<30s
15	Lookup of Energy Assessor (aka. Energy Assessor Register; Energy Assessor Validity Check)	Non-Dom	Y	Y	Y	Y	n	<15s	<0.2s	<10s
16	Search Energy Assessor Register Index (aka. Energy Assessor Validity Check)	Dom	n	Y	Y	Y	n	<1m	<0.3s	<10s
17	Update Energy Assessor Index	Non-Dom	Y		Y	n?	Y	<1m	<0.007s	<30s
18	Update Consolidated Energy Assessor Register	Dom	n		Y	tbd	tbd	<8h	<0.006s	<30s
19	Produce regular data extracts and reporting to DCLG	Non-Dom	Y			n?	Y	none	tbd	
20	Central Information Point (CIBSE Benchmark Tables, Degree Days	Non-Dom	Y		Y	Y	Y	<30s	<0.3s	<30s

	Data, CO2 Emission Factors, Area Conversion Factors, Energy improvement Measures)									
21	High Level Lodgment Statistics	Non-Dom	n	Y	n	Y				
22	High Level Lodgment Statistics	Dom	n	Y	n	Y				
23	Accreditation Scheme annual reports	Dom	n	Y	n	Y				

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