COBRA 2016

Toronto, Canada

20 - 22 September 2016

Supported by:

rics.org/cobra

RICS COBRA 2016

The Construction, Building and Real Estate Research Conference of the Royal Institution of Chartered Surveyors

Held in Toronto, Canada in association with George Brown College

20 - 22 September 2016

ISBN: 978-1-78321-160-9

ISSN: 2398-8614

Royal Institution of Chartered Surveyors

Parliament Square

London

SW1P 3AD

United Kingdom

www.rics.org/cobra

UNDERSTANDING THE ROLE OF OBSOLESCENCE IN PPP/PFI

Professor Michael Pitt[1], Peter McLennan[2] and Kieran Mulholland[3]

[1] *Institute for Environmental Design and Engineering, University College London, Gower Street, London, WC1E 6BT, UK | email: P.Mclennan@UCL.ac.uk*
[2] *Institute for Environmental Design and Engineering, University College London, Gower Street, London, WC1E 6BT, UK | email: Michael.Pitt@UCL.ac.uk*
[3] *School of Civil, Environmental and Geomatic Engineering, University College London, Gower Street, London, WC1E 6BT, UK | email: Kieran.Mulholland.13@UCL.ac.uk*

ABSTRACT

In 2013 the Guardian newspaper reported that the UK Government had acquired £300 billion worth of capital costs and unitary payments within the formally known Private Finance Initiatives – now Public Private Partnerships. This paper is not about the economics or moral debate upon the success and failures of PPP's within the UK, but rather the untold story of the impact of obsolescence upon the integral asset systems which support the service delivery. Prisons require supportable and maintainable security systems, the same can be said for government/defence buildings, not to the mention the life critical systems within hospitals and clinics across the country. However, there is an untold story, which is impacting the through life or lifecycle costs to support and maintain key asset systems, driving additional lifecycle expenditures that may be unforeseen. This paper contains evidence of the scale of the financial impact of obsolescence through obsolescence driven investments, not least to mention the potential operational impacts if systems become unsupportable. This paper begins to create a foundation for future research focusing on obsolescence and how best to monitor and mitigate its effects.

Keywords: ppp/pfi, obsolescence, asset management, lifecycle, risk.

INTRODUCTION

In 2014 the UK Government reported that there were in total 728 live public private partnerships (PPP), shown in Figure 1, which amounted to a total of £56.5bn in capital value and would peak at £10bn in annual unitary payments to the private sector (HM Treasury 2014). The education and health sectors are the largest in both quantity and capital value. Many of these PPPs will be new build construction projects, however, some may be redevelopment projects, in both cases systems are overhauled or fitted in accordance with the contractual agreement. Depending upon who retains the lifecycle responsibility for the assets, these systems will be required to be supported for the remainder of the PPP length, with planned preventative maintenance regimes in place. The average length of current PPPs within the UK is 27 years, taking the case study PPP, assets such as Building Management System, Fire Alarm System and Security System all contain components that have life expectancy schedules of less than 10 years. Considering all of the above, logic would suggest that through life support or planning is required in order to sustain the systems until contract closure.

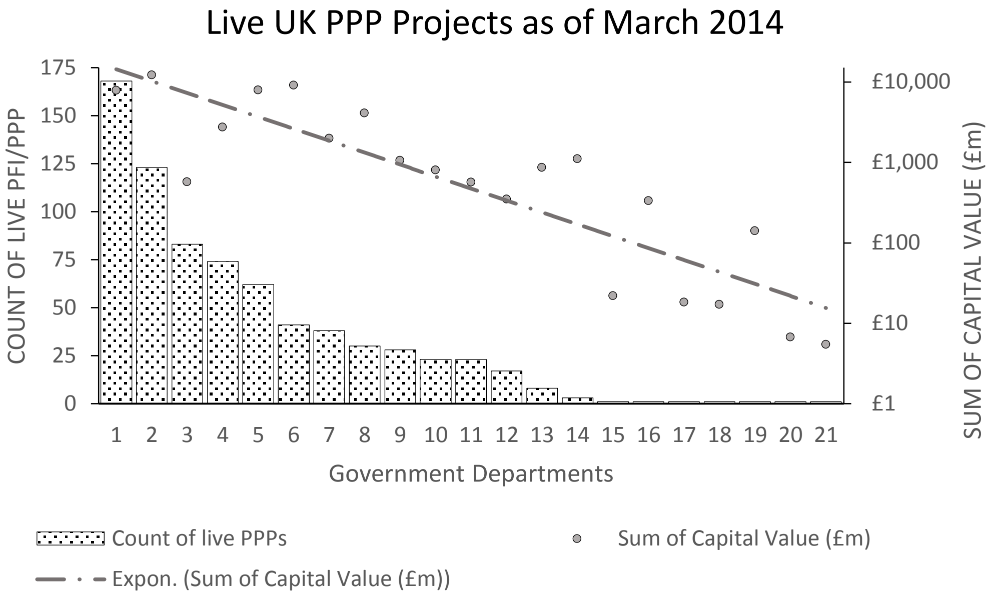

Figure 1 Live UK PPP Projects as of March 2014 adapted from HM Treasury (2014) – x axis key found in appendix A.

Please note that PPP contracts vary from site to site, therefore how the case study contract in question is structured may not be applicable to other cases studies.

Lifecycle planning and Asset Management techniques have proved to be sufficient with long term lifecycle planning, however, there is a big caveat that exists within current British Standards regarding obsolescence. The agreed definition of obsolescence refers to a component that is no longer suitable to current demands or is no longer supported by a manufacturer (Singh et al. 2004; BSI 2007; Bartels et al. 2012; CMCA UK 2013). There is no current agreed methodology as to how a Facilities Manager should manage or mitigate the effects of obsolescence, epitomized by the following statement within BS ISO 15686-2:2012 – Buildings and Constructed Assets: Service Life Planning:

> "It does not cover limitation of service life due to obsolescence or other non-measurable or unpredictable performance states." - (BSI 2012)

It is exactly this 'non-measurable' and 'unpredictable' view upon obsolescence and the apparent gap with regards to management approach, that is the core focus of the paper. Evidence is provided to illustrate the additional lifecycle costs associated to reactive obsolescence management. Highlighting the operational risk associated with unforeseen lifecycle expenditures and the observed cyclical behavior within the subject case study.

CONTEXT

This paper contains research from an ongoing Engineering Doctorate research project at the University College London. The literature review featuring within the thesis has highlighted that this paper along with adjacent journal/conference papers produced by these authors are the first to explore the effects and role of obsolescence within PFI/PPPs. The findings found herein therefore are novel and set a field for extensive further research into not only understanding obsolescence to a greater level, but devising new mitigation processes that are viable for an end user.

In the field of obsolescence, especially regarding long life systems – similar to those found within the Built Environment, there are several prominent researchers. Professor Peter Sandborn of Maryland University, USA is comprehensively the most cited, along with his work with Pameet Singh. Sandborn's (2008) paper gives a succinct background to recent developments within the field of obsolescence and it is recommended that Solomon et al. (2000), Bradley & Guerrero (2008), Sandborn (2008b) and Bartels et al. (2012) are reviewed to see other relevant pieces of literature.

The fundamental difference between research that precedes this, can be summarised by the research perspective. Traditionally, the research cited above is in partnership with manufacturers and distributors seeking to optimise replacement strategies and new product lines. Such research is based upon large sales databases, looking to extrapolate and project lifecycle curves. Such insight created by data mining is very advantageous, however not accessible for the end user, in this case the Facilities Manager who is responsible for a large asset register.

METHODOLOGY

This paper has adopted a case study methodology, using a 30-year redevelopment PFI tasked to refurb a fifteen story, neoclassical, multi-purpose Grade 1 listed office building in central London, UK. The data and analysis that follows is a result of a two-year research project, where the planned lifecycle expenditure was compared to purchase order (PO) activity. In order to extract the following data, the author was embedded into the business recording first hand not just how the data is quantitatively produced, but gaining a qualitative assessment of the internal processes.

This two-year expose resulted in the collection of data spanning several decades, allowing for analysis to extract the direct impact of obsolescence to a level of detail not previously published.

MAIN DISCUSSION

In many complex long life systems, their need for sustainment comes from immediate financial repercussions i.e. Abili et al's (2013) case study on off shore oil rigs and the cost of production downtime. Similarly, Stogdill (1999), Flaherty (2005) and Connors (2005) cover the effects of obsolete components within military weapon systems and the large spiralling costs associated. This to some degree does apply to the Built Environment, epitomised through the payment mechanisms within PPPs. However, many Facilities contain life critical systems, which if un-operational have both a financial and operational risk i.e. hospitals and uninterruptable power supply (UPS) systems.

BS 8544:2013 and the CIBSE guide for maintenance engineering are widely used within the Facilities Management industry to through life plan the lifecycle of assets, these guides have proved to be sufficient in regards to lifecycle costing and planned preventative maintenance regimes (BSI 2013; CIBSE 2008). These standards however exclude detailed consideration of obsolescence and/or how to manage its effects. Typical guidance would include the use of spare parts and cannibalising existing elements within the system through upgrades (Marshall & Lambert 2008; Gravier & Swartz 2009; Rojo et al. 2011). Firstly, to successfully undertake these mitigation methods a certain amount of knowledge and system expertise is required in house. Secondly capital is required to make these investments, which will therefore become 'locked' and depreciate – something that may be unattractive within the PPP market.

Initial discussions with senior management of the special purpose vehicle (SPV) identified that obsolescence related investments were causing significant spikes in the planned lifecycle expenditure. This resulted in the Building Management, Fire Alarm and Security systems to be isolated for analysis and comparison of obsolescence driven investments. These respective assets also contain high levels of technology, which is important for two reasons; technical/compatibility issues are likely and they are also vulnerable to technological advancements within the consumer market (Bartels et al. 2012; Grover & Grover 2012; World Economic Forum 2015).

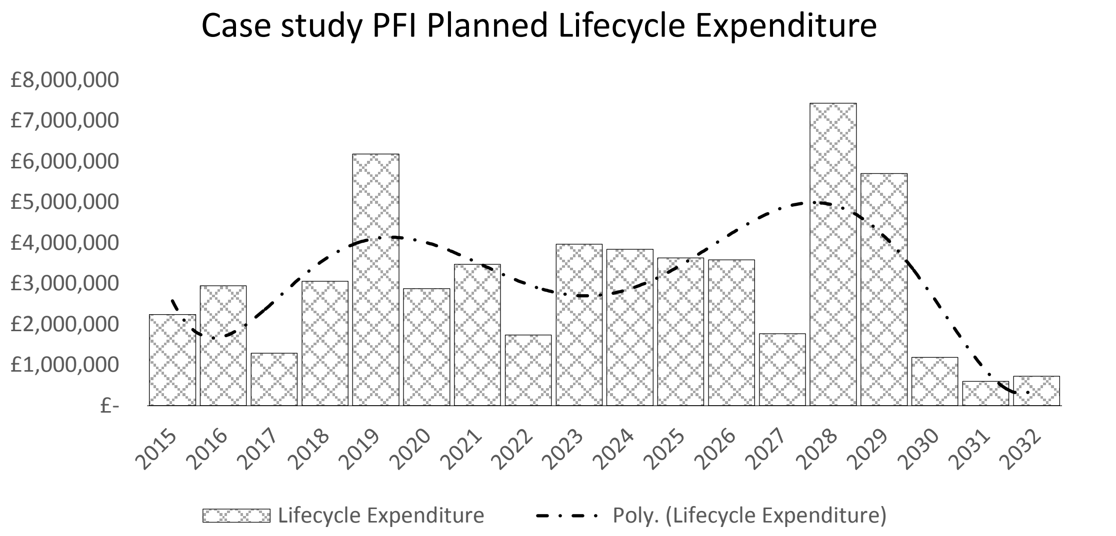

Figure 2 Case study PFI Planned Lifecycle Expenditure

Figure 2 illustrates the remaining planned lifecycle expenditure of the case study PFI, built upon current techniques as guided by British Standards and CIBSE. It is typical for such profiles to contain cyclical peaks, where larger systems receive planned investment. This is a preferred approach as it 'groups' components of similar lifecycles together, allowing for the profile to be forecasted further ahead for the next lifecycle iteration.

In order to explore the role of obsolescence within PPPs this research project gathered and inspected historical purchase patterns and compared this against the planned expenditure (show in Figure 3). Admittedly a small window to take an opinion from, however, a decade on from installation the three case study assets alone appear to spike in obsolescence related investments. Note, there was no planned lifecycle investment into these systems between the years 2012 to 2015. This creates more than one problem; additional works are now required within the calendar years shown below, how can we quantify the impact this premature investment will have upon the preceding lifecycle plan for these assets? And finally, how did these investments impact the SPV financially? It is very apparent how unforeseen obsolescence related investments into critical long life asset systems, create a plethora of operational and financial questions, which currently have no detailed guidance to either foresee or mitigate.

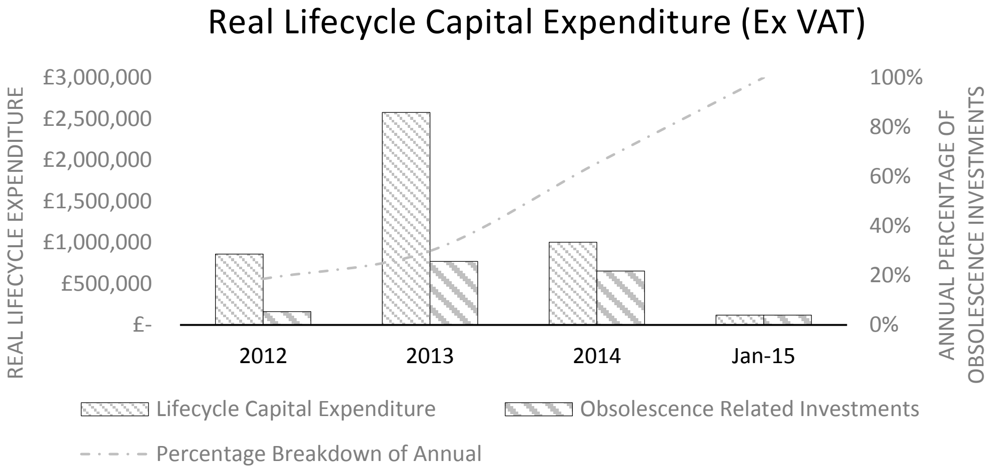

Figure 3 Real Lifecycle Capital Expenditure of Case Study

Initial thoughts on Figure 3 arrived to two questions; is the occurrence of obsolescence driven investments a cyclical pattern, that occurs in a 5-year time step? Or due to the range of assets, will it simply occur every year but at varying levels? In response to these questions, it was highlighted that a significant percentage of the annual lifecycle expenditure was concentrated within these three assets alone, there is bias at play yes due to the selection process. However, it would seem fair to assert that due technology currently being concentrated to a few systems, that the behaviour observed in Figure 3 is likely to occur on a cyclical pattern. Note, wider literature covering the Internet of Things (IoT) and Big Data would suggest a trend to continual increasing of technology within the Built Environment.

This case study has begun to demonstrate that the behaviour of obsolescence within key systems across our Built Environment, requires better understanding. The impact of reactively managing obsolescence can have significant financial and operational impacts. Connected to this point, current asset management and lifecycle guidance, whilst sufficient with through life planning, appears to fall short when considering obsolescence. From a purely PPP perspective, the role of accurately costing the lifecycle across long contracts does not have a tried and tested approach for accounting for these unforeseen investments.

SUMMARY

In summary, the management of obsolescence has been addressed in many industries and typically by manufacturers and niche markets i.e. military. There is no significant research currently that has begun to explore how the end user, or in this case Facility Managers, can gather information to begin shifting from a reactive to proactive stance.

The case study that features within this paper has been extracted from a Engineering Doctorate (EngD) research project at the University College London (UCL), where asset management and risk management tools are currently being developed and tested.

The main discussion section of this paper has explored the role that obsolescence appears to play within a long term PPP projects, however, in order to answer the ‘so what’ question Figure 4 was created. Figure 4 was created taking the observed levels of obsolescence within the case study assets and then placed into a 5-year time step iteration. This profile was then placed upon the case study planned lifecycle expenditure to observe the impact both upon the profile and the accumulative costs.

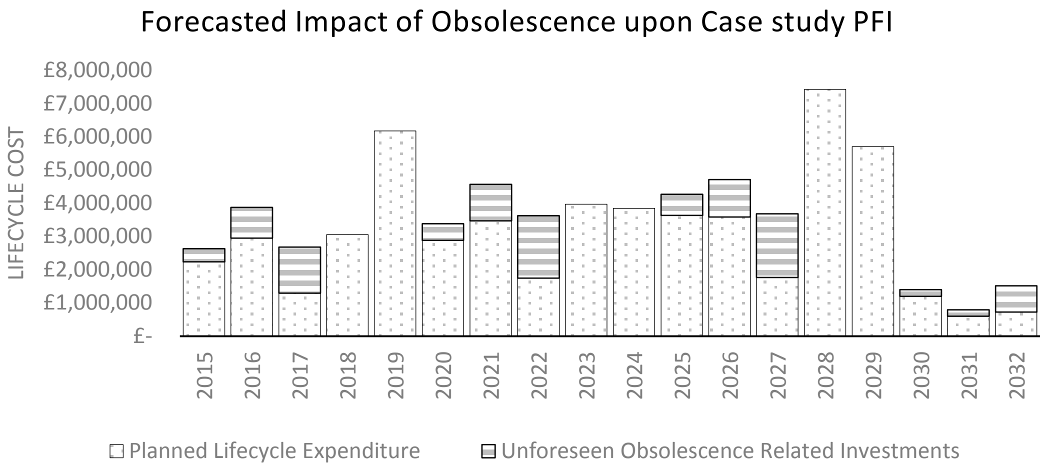

Figure 4 Forecasted Impact of Obsolescence upon Case Study PFI

The short term effects of obsolescence within this case study, will likely manifest themselves within the years 2021-2022, where there is significant increase upon the planned investment. This analysis is excluding the possible operational impact of having un-operational critical systems. However, such a spike in expenditure has the potential to push the SPV beyond its finance threshold with the sponsoring bank. There are additional impacts such as the ability of the Asset Manager or Facility Manager to adjust their planned lifecycle budgets. Without consideration for obsolescence it is also likely that such a profile will appear as negligent management when reporting to board level as they are unforeseen.

The long term effects of the above forecast result in an additional lifecycle expenditure (unforeseen expenditure) of £11 million over a 17-year period, taking the total remaining lifecycle commitment to £67 million (16% increase). A significant amount. As of March 2014 the live PPPs in the UK had a remaining total of ~11,000 years, taking an £11 million cost across 17 years and extrapolating that across the remainder of the PPP sector, the estimated costs of obsolescence related investment reaches £7 billion (HM Treasury 2014). Please note these are indicative, PPP projects vary greatly and therefore the likelihood of obsolescence and also costs associated will naturally vary.

CONCLUSIONS AND RECOMMENDATIONS

Referring back to the title of this paper, this paper has scratched the surface of obsolescence within long life asset systems that are common across the Built

Environment. The financial impact of obsolescence within these systems have been explored through both historical analysis and forecasting across a PPP. There is evidence in this paper that suggests that not only are the costs related to obsolescence within PPPs unreported but significant in their size.

The key conclusions of this research paper are; depending upon the purpose of the PPP, that obsolescence may occur in a cyclical manner and be concentrated within a select few systems (80:20 rule). There also appears to be a lack of accepted management practice or tools to use when mitigating obsolescence across the Built Environment.

The recommendations of the author are to both address the above findings and also explore contrasting PPP contracts. Adding further evidence to the claim that obsolescence driven investments get insufficient attention both in pre contractual talks and also through life planning of assets. This can only be addressed via a case study methodology over a longer time period. This paper in connection with the adjacent EngD research project at UCL, creating a foundation upon where future work is required to gather more information into how obsolescence manifests itself, behaves and therefore how best to cost and mitigate its effects.

REFERENCES

Abili, N., Onwuzuluigbo, R. & Kara, F., 2013. Subsea controls future proofing: A systems strategy embracing obsolescence management. *Underwater Technology: International Journal of the Society for Underwater*, 31(4), pp.187–201. Available at: http://openurl.ingenta.com/content/xref?genre=article&issn=1756-0543&volume=31&issue=4&spage=187 [Accessed February 10, 2014].

Bartels, B. et al., 2012. *Strategies to the Prediction, Mitigation, and Management of Product Obsolescence* 1st ed., New Jersey: John Wiley & Sons Inc.

Bradley, J.R. & Guerrero, H.H., 2008. Product Design for Life-Cycle Mismatch. *Production and Operations Management*, 17(5), pp.497–512. Available at: http://search.proquest.com/docview/228681941?accountid=14511.

BSI, 2012. *Buildings and constructed assets — Service life planning Part 2 : Service life prediction procedures*, London BS ISO 15686-2:2012.

BSI, 2013. *Guide for life cycle costing of maintenance during the in use phases of buildings*, London BS 8544:2013.

BSI, 2007. *Obsolescence management — Application guide*, London BS EN 62402:2007.

CIBSE, 2008. *Maintenance engineering and management*, London: The Chartered Institute of Building Services Engineers. Available at: http://www.cibse.org/.

CMCA UK, 2013. What is Obsolescence Management? Available at: http://www.cmcauk.co.uk/what-is-obsolescence-management/ [Accessed January 4, 2014].

Connors, T.J., 2005. Managing obsolescence takes commitment to “best practices.” *Military & Aerospace Electronics*, 16(8), pp.9–10. Available at: http://search.proquest.com/docview/216289006?accountid=14511.

Flaherty, N., 2005. New parts for old. Thinking ahead is the only key to managing the burgeoning problem of component obsolescence. *Institution of Engineering and*

Technology, (January), pp.34–37.

Gravier, M.J. & Swartz, S.M., 2009. The dark side of innovation: Exploring obsolescence and supply chain evolution for sustainment-dominated systems. *The Journal of High Technology Management Research*, 20(2), pp.87–102. Available at: http://linkinghub.elsevier.com/retrieve/pii/S1047831009000194 [Accessed February 11, 2014].

Grover, R. & Grover, C., 2012. Obsolescence - a cause for concern? *Journal of Property Investment & Finance*, 33(3), pp.1–9.

HM Treasury, 2014. *Private finance initiative*, London. Available at: www.gov.uk/government/publications.

Marshall, M.M. & Lambert, K.R., 2008. Insights into supporting complex systems under conditions of obsolescence. *PICMET '08 - 2008 Portland International Conference on Management of Engineering & Technology*, pp.1918–1923. Available at: http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=4599811.

Rojo, F.J.R. et al., 2011. A study on obsolescence resolution profiles. *Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture*, 226(1), pp.167–177. Available at: http://pib.sagepub.com/lookup/doi/10.1177/0954405411407565 [Accessed January 3, 2014].

Sandborn, P., 2008a. Trapped on Technology's Trailing Edge. *Spectrum IEEE*, 45(april), pp.43–58.

Sandborn, P., 2008b. Trapped on Technology's Trailing Edge. *IEEE Spectrum*. Available at: http://spectrum.ieee.org/computing/hardware/trapped-on-technologys-trailing-edge [Accessed January 25, 2016].

Singh, P., Sandborn, P. & Singh, P., 2004. Forecasting Technology Insertion Concurrent with Design Refresh Planning for COTS-Based Electronics Systems. *Logistics Spectrum*, pp.349–354. Available at: http://www.enme.umd.edu/ESCML/Papers/solemocapaper.pdf [Accessed February 11, 2014].

Solomon, R., Sandborn, P. & Pecht, M., 2000. Electronic part life cycle concepts and obsolescence forecasting. *... , IEEE Transactions on*, 23(4), pp.707–717. Available at: http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=888857 [Accessed January 13, 2014].

Stogdill, R.C., 1999. Dealing with obsolete parts. *Design & Test of Computers, IEEE*, (June), pp.17–25. Available at: http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=765200 [Accessed January 4, 2014].

World Economic Forum, 2015. *Deep Shift Technology Tipping Points and Societal Impact*, Geneva, Switzerland. Available at: http://www3.weforum.org/docs/WEF_GAC15_Technological_Tipping_Points_report_2015.pdf.

APPENDICES

Appendix A

The key to figure 1

1	DEPARTMENT FOR EDUCATION (GROUP)
2	DEPARTMENT OF HEALTH (GROUP)
3	SCOTTISH GOVERNMENT (GROUP)
4	DEPT FOR COMMUNITIES AND LOCAL GOVERNMENT (GROUP)
5	DEPARTMENT FOR TRANSPORT (GROUP)
6	MINISTRY OF DEFENCE (GROUP)
7	NORTHERN IRELAND EXECUTIVE (GROUP)
8	DEPT FOR ENVIRONMENT, FOOD & RURAL AFFAIRS (GROUP)
9	HOME OFFICE (GROUP)
10	MINISTRY OF JUSTICE (GROUP)
11	WELSH ASSEMBLY GOVERNMENT (GROUP)
12	DEPARTMENT FOR CULTURE, MEDIA AND SPORT (GROUP)
13	HM REVENUE AND CUSTOMS (GROUP)
14	DEPARTMENT FOR WORK AND PENSIONS (GROUP)
15	DEPT FOR BUSINESS INNOVATION AND SKILLS (GROUP)
16	SECURITY AND INTELLIGENCE AGENCIES (GROUP)
17	CROWN PROSECUTION SERVICE (GROUP)
18	FOREIGN AND COMMONWEALTH OFFICE (GROUP)
19	HM TREASURY (GROUP)
20	CABINET OFFICE (GROUP)
21	DEPARTMENT OF ENERGY AND CLIMATE CHANGE (GROUP)