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# Unleashing EA: Institutional Architectures and the value of joined up thinking

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## Executive Summary

At the beginning of 2008, JISC funded a twelve-month Pilot programme of projects to explore the applicability of Enterprise Architecture (EA), a strategic management technique for enabling large companies to adapt to change, to the higher education operational context. Although largely unknown in the education sector, EA has been widely adopted over the last 15 years in the commercial world and in public sector organisations. JISC saw boot-strapping EA work in the HE sector as part of its overall remit of helping institutions to move forward, to use technology in effective ways and to undertake day-to-day business more effectively.

There are a number of frameworks that have been developed over the years to support EA. One of the main purposes of the Pilot was to explore and evaluate the practical realities of using one of these frameworks, TOGAF, in a HE institutional setting. This was done by asking two questions: firstly, how useful is EA to HE as a sector? Secondly, how suitable is TOGAF as a framework for undertaking EA in an educational setting?

This report summarises the main debates and learning points, and provides conclusions, analysis and recommendations based on the knowledge generated by the Pilot projects. These conclusions and recommendations are provided at the end of each main section and build up the bigger picture over the course of the report. Finally, in line with TechWatch's horizon scanning remit, the report provides informed speculation on the future of EA in HE that goes beyond the original programme parameters. It looks at issues across the sector and makes recommendations to combine existing work on low carbon ICT with new work on procurement, and to broaden the perspective on EA tools to take in work needed on procuring open source software. Busy managers can get an overall view of the main arguments the report presents by reading the 'conclusions and analysis' sub-sections together with section 8.

In brief, what has emerged is an approach to EA that is both broad and deep, vertical and horizontal. At the intra-institutional, or vertical level is pragmatic EA, the 'table top and legs' approach to EA; at the inter-institutional level is peer-to-peer EA, an approach which takes in the big picture technological and strategic drivers, for example SOA and Shared Services, and cashes in on HE's strength – its ability to share and learn from others.

Whilst there were no definitive answers to the two main questions asked at the beginning of the Pilot programme it is fair to say that EA has found sufficient support from this first cohort of projects to warrant further work across the sector, and an Enterprise Architecture Practice Group is being established with representatives from a range of UK HEIs. In the longer term it is likely that the staff from these institutions, who take the EA message to heart at this early stage, will shore up a permanent advantage for their institution in managing change and developing an agile IT infrastructure.

The overall conclusion is that the vision for EA in HE needs to be brave and bold. Making a success of EA within the sector will require an uncompromising focus on the big picture vision, both within institutions and across the sector.

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## 1. Introduction

Senior managers in higher education (HE) and further education (FE) currently face a number of operational and strategic challenges including an increasingly competitive environment, the need for efficiency savings, as well as the shifting sands of new initiatives and changing technology. ICT is often regarded as a key part of the solution to these pressures, but although universities and colleges have invested enormously in business and ICT systems in recent years there remains considerable frustration with institutional capabilities to manage day-to-day operations and handle the pressure for change. Warning signs that all is not well will be all too familiar to senior information services managers in HE/FE:

- Data exists in 'silos'. Significant work is needed to take data from one system, manipulate it and enter it into another system.
- Business process duplication means that the same activity is being completed by different systems across the institution.
- Lack of information integration means that staff and students have to visit multiple systems to get the information they need for daily work.
- Meeting new regulatory or reporting requirements is a major effort because the information needed to make key decisions is not available.
- Work processes and practices, knowledge and skills and supporting ICT systems are not well integrated to provide strategic capabilities.
- Senior management just don't know whether the institution gets good value from investment in ICT systems.

The general consensus is that across HE and FE there is little high-level, strategic impetus behind the integration of institutional ICT and there are considerable concerns around cost, performance and control (see, for example, Boys and Ford, 2008; Olivier, 2007). Research carried out by JISC (Duke et al., 2008) concluded that: "generally there are significant shortcomings in the capability of senior management teams in HEIs [higher education institutions] to identify and exploit the full strategic potential of technology" (p. 2).

In order to try to address some of these issues, at the beginning of 2008 JISC funded a 12-month Pilot Programme to explore the applicability of Enterprise Architecture (EA), a strategic management technique for enabling large companies to adapt to change, to the higher education operational context. Although largely unknown in the education sector, EA has been widely adopted over the last 15 years in the commercial world and in public sector organisations. The claims made for EA are that it provides an evolving, dynamic way of describing and aligning the functional aspects of an organisation: its people, activities, tools, resources and data/information, so that they work more effectively together, and therefore more efficiently, to achieve the organisation's business goals.

There are a number of frameworks that have been developed over the years to support EA. Prominent examples include: Zachman, Federal Enterprise Architecture Framework, and The Open Group Architecture Framework (TOGAF™). One of the main purposes of the Pilot was to explore and evaluate the practical realities of using one of these frameworks, TOGAF, in a HE institutional setting. This was done at two levels: developing an understanding of what is involved when undertaking EA work in general, and exploring the particular issues associated with using TOGAF.

JISC took the view that EA might offer the potential both to help institutions improve their strategic management of ICT, and to make use of the benefits of service-oriented software development (see section 2). JISC saw boot-strapping EA work in the sector as part of its overall remit of helping institutions to move forward, to use technology in effective ways and undertake day-to-day business more effectively.

The Pilot projects worked closely with a team from The Open Group, an international membership-based organisation dedicated to the development and promotion of open standards in ICT. Three universities started the Pilot in April 2008: Cardiff University, King's College London (KCL), and Liverpool John Moores University (LJMU), with a fourth project from Roehampton University joining the programme later in the year. Colleagues from other institutions including Nottingham Trent University, the JISC InnovationBase, the International e-Framework Initiative, TechWatch, CETIS and The Open Group also took part in some or all of the project meetings and workshops as an embryonic expertise group started to form. Specialist training was also provided by expert practitioners from Infosys Ltd and BiZZdesign.

This report synthesises the learning outputs of the Pilot programme and places them in the context of JISC's continuing work in this area. Conclusions and analysis from the knowledge generated by the Pilot projects are presented at the end of each main section to provide summary and interpretation that accumulates over the course of the report. Finally, in line with TechWatch's horizon scanning remit, the report provides informed speculation on the future of EA in HE and identifies areas for future activity. Busy managers can get an overall view for the main arguments the report presents by reading the 'conclusions and analysis' sub-sections together with section 8.

Details of the pilot process, longitudinal case studies from each of the projects, as well as introductions to EA, TOGAF and The Open Group have already been published in the JISC TechWatch Early Adopter Study, *Doing Enterprise Architecture: Enabling the agile institution*<sup>1</sup>, and readers new to the field of EA are advised to read the study before attempting this report.

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<sup>1</sup> Available at: <http://www.jisc.ac.uk/whatwedo/services/techwatch/reports/earlyadopters.aspx>.

## 2. The value of joined up thinking

When computer systems were first introduced to HE there was a great deal of in-house, bespoke software development which aimed to produce an exact, localised solution to operational requirements. In the 1980s, as the scale and complexity of applications grew rapidly, there was an attempt to build suites of software that universities could all take advantage of. However, this attempt at developing sector-wide solutions – the Management and Administrative Computing (MAC) Initiative – was not sufficiently agile to adapt quickly enough to the technological rate of change, and it was eventually abandoned. Instead, there was a move towards the use of external commercial vendors (Liber, 2009). A number of companies specialising in specific education-related applications have emerged and many others have worked to reconfigure existing commercial systems (for example Enterprise Resource Planning [ERP] systems) for the education market. Although this has been relatively successful there are numerous issues with regard to getting exactly the right solution, problems with vendor lock-in and cost of switching, and being exposed to the vagaries of the commercial software market.

### 2.1 The Shared Services vision

In response to this, recent years have seen some universities start to work together, through consortia, to develop shared solutions to common problems<sup>2</sup>. In some ways, these consortia hark back to the MAC initiative, but with some important distinctions.

First of all, there is the growing political drive towards what is referred to as Shared Services which, it is hoped, will provide greater efficiencies by getting parts of the public sector to share the burden of particular operational tasks (these ideas are not entirely new to tertiary education – the JANET network is a primary example of the 'shared' approach<sup>3</sup>). Secondly, most institutions operate a 'mixed environment' in which at least three ways of tackling major information systems issues present themselves: in-house development, reconfiguring existing commercial solutions, and community-based, sector-wide developments. This complexity, taken together with the shared services agenda and an increasing need to respond rapidly to changing technology requirements points to a general need for more agile information systems that can support greater flexibility. Finally, recent developments in application software engineering mean that a 'services' approach to software development makes it easier to task to develop and manage systems that are more agile. This is the emerging agenda of software services.

### 2.2 The service-oriented approach

The service-oriented approach (or soa) to software development involves a relatively simple idea: to identify and develop software components that provide a single service that can be re-used in many places. This type of approach is implemented through a Service Oriented Architecture (SOA), commonly (although not always) structured around an Enterprise Service Bus (ESB) and utilising Web Services technologies<sup>4</sup>.

An information system designed in a service-oriented way seeks to re-use many software services, and in the process to become more efficient and more adaptable to the business

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<sup>2</sup> Examples of this approach include Sakai and Quali.

<sup>3</sup> For more detail on the strategic significance of Shared Services, see section 1.2 of the TechWatch Early Adopter Study (referenced as TechWatch, 2009).

<sup>4</sup> Further details on the distinction between soa/SOA, or 'little SOA' and 'big SOA' (as they apply to HE) are available from: <http://soa.cetis.ac.uk/soa-pack>

needs of the institution. Such a way of working, if adopted as widely as possible, helps get around the difficult problem of deciding which IT development route is best (i.e. commercial/in-house/consortia). By moving to a services-based infrastructure, software applications from all three different ways of working could, in theory, share information with each other and co-operate. There is also the considerable added benefit that existing, legacy systems can in effect 'join the party' by having their underlying applications 'exposed' as a service that is made available to other systems. Existing collections of data can also be exploited in new ways across the campus. Finally, a services-based infrastructure offers opportunities for exposing and integrating software in different institutions (and thus may form part of the emerging Cloud Computing and shared services agendas). In a nutshell, soa offers the potential for a much more agile IT infrastructure.

In fact, the power of the software services idea can be applied to business processes as much as to software. Lankhorst *et al.* (2005) argue that the service concept provides a mutually understood 'language' for debates between software developers and business staff: something that forms an important part of EA work. However, this is not without its own inherent difficulty. The opportunity and flexibility it provides throws down an enormous challenge to university management to be clear about what it wants and requires from the institution's information systems. To take full advantage of the services paradigm, senior management need to have a view about the institution's data (who has ownership and responsibility for what), what services need to be created and which legacy systems to expose.

This takes the provision of services beyond the technical realm of software specification and development and into the area of strategic management: looking at how data and applications can be used to assist with the business goals and higher-level management of the university. As such this is 'beyond the pay grade' of the IS department and takes the services agenda into wider discussions about how to align IT systems with business objectives – in effect how to architect the information infrastructure.

### **2.3 Facilitating joined up thinking**

Part of JISC's role is to co-ordinate inter-institutional activity and in relation to EA there are two key initiatives that need specific mention.

#### **2.3.1 The International e-Framework Initiative**

The e-Framework, which receives significant funding from JISC, has been established to help higher education and research take advantage of the opportunities offered by the service-oriented approach. The e-Framework seeks to express the future of university institutional processes and systems through the emerging services-oriented paradigm. Its primary goal is to facilitate technical interoperability within and across education and research through improved strategic planning and implementation processes. It seeks to map the complex software and technical environments that present themselves in universities and colleges as viewed through the filter of a services-based approach. It sets out to achieve this through the use of open standards, provision of a consistent technical vocabulary, a growing knowledge base of service descriptions, workplace scenarios, process models and use cases, as well as open and collaborative, community-based methods of working.

#### **2.3.2 JISC InnovationBase**

More recently, JISC has funded the InnovationBase (IB) – a 'knowledge repository' that

holds information on how higher education institutions function, in particular their work processes, roles, systems/applications and various artefacts that support these. The IB has been developed as a complementary service to the e-Framework, providing a high level view of the lifecycles of business processes within HE. Its development is being managed by the IB Development Team (split between Manchester University and University of Southampton), who are part of the wider JISC Community Engagement Team (CET). At the time of writing the project had not been formally launched although some further details are at: <http://cet.jisc.ac.uk/innovation-base/>.

The IB is seen as having the potential to offer HE staff working on EA with a convenient way to share models and to work together on architecture-related issues. Indeed, it is envisaged that enterprise architects within HEIs will be one of the key groups of staff involved in creating content for, and making use of the IB as it develops over the next few years. The IB is capable of taking information on enterprise architectures from TOGAF and it is believed that information will be capable of being exported from some EA tools, for example, BiZZdesign (see section 4).

Through the IB, the hope is that common models will emerge that can be used to compile parts of a generic reference model for universities. These reference models will then become potential candidates for the development of a shared service.

## 2.4 Conclusions and analysis

*"Purely institutional [software services] reuse is still only of relatively limited benefit. The real value of reuse is to be gained through the commoditisation of [software] services, with both a consequent dropping of price and enhanced ease of integration"*  
(Olivier, 2009, section 3.4).

Universities and colleges are beginning to appreciate the potential benefits of working together to solve operational and information management issues. The drivers for this include a perceived need for greater operational agility, the recognition of the difficulties inherent in making exclusive use of commercial, third party ICT solutions and the shared services agenda. Developments in software engineering and information architecture, through the emerging 'services' approach, can help greatly with these issues but there is, to coin a phrase, a need for 'joined up thinking' and a renewed focus on the strategic management of information systems and data. JISC has a role to play in this area, not only as a provider of timely information but as co-ordinator and facilitator of a number of inter-institutional initiatives, and Enterprise Architecture offers a powerful management technique to help with this process.

### 3. Enterprise Architecture

Enterprise Architecture (EA) is a high-level, strategic technique designed to help senior managers achieve business and organisational change. It provides an evolving, dynamic way of describing and aligning the functional aspects of an organisation, its people, activities, tools, resources and data/information, so that they work more effectively together to achieve its business goals. EA is also about achieving desired future change through design. It holds that by understanding existing information assets, business processes, organisational structures, information and application infrastructure (the 'as is' state) it is possible to 'do something different' (the 'to be' state). Whilst this may seem similar to some of the aims of the e-Framework – both have similar goals in that they aim to define business and technical artefacts using consistent vocabulary – there are in fact some important things to note:

- EA is bigger in scope than the e-Framework, since it seeks to model the wider socio-technical environment of an organisation rather than software.
- To a certain extent the outputs have different audiences: e-Framework tends to be for software developers and business process analysts while EA has a much wider audience and various levels of stakeholder from senior management downwards.
- Developing the e-Framework and EA in isolation could lead to duplication.

This section begins with a summary of some of the key discussions that took place, which sets the parameters for the conclusions and analysis that come at the end of the section. EA tools has been given a separate section due to its size.

#### 3.1 Scale, scope, and HE as a 'special case'

Although EA has been deployed in industry for over 15 years, one of the fundamental questions the Pilot projects had to try to answer was whether or not EA was suitable for application in a HE institutional setting. One issue is the sheer complexity of a large, modern campus, and although the feeling among various consultants was that this is no different to the international corporations that have pioneered EA, project staff were more reticent to agree with this. Indeed, whilst it's important to remember that TOGAF emerged from work carried out by the US Department of Defense, a very large and complex organisation, it is probably fair to say that there are other criteria at play within universities that make a 'like for like' comparison unreliable.

For example, the collegiate system, common among older universities, follows a highly federated 'community of scholars' model. Indeed, some of the consultants used by the projects found it difficult to understand how HE worked, for example, failing to understand why various departments in a university wouldn't all pull together in certain instances. Another example came out of a discussion with project staff about the TOGAF training where there was some frustration over the examples used to illustrate key TOGAF concepts. It was felt that the industry cases used were so dissimilar to the UK HE setting as to render the analogy useless for training purposes. Comments like this are useful – not only do they emphasise the degree of difference between industry and academia but they pinpoint a context – in this case the core operating model as a source of difference/conflict – and we return to some of these issues in a later section.

Added to this were concerns around the scale and complexity of work involved in undertaking EA, sometimes expressed as being like 'trying to boil the ocean' and this

revolved around a number of key questions:

- What is the correct scope to initially work at: the whole institution, an individual department or a single project?
- Who should be involved in the process as stakeholders and what level of senior management commitment is required?
- Should an institution start with the 'as is' side of EA or the 'to be'?
- Does HE have the level of business planning and strategic vision required by the 'to be' phases of EA?

Debates around scope mainly revolved around what constitutes 'the enterprise'. It was generally agreed that getting the scope right and agreed from the start is absolutely critical to successful EA work but whether that should be across the entire institution, at departmental level or even at the level of a single, cross-campus project, was a matter of contention.

A valuable source of insight was the cumulative experience of Dutch universities who have been investigating the use of EA over the last few years. The lessons emerging there seem to suggest that the best approach, at least initially, is to start working on an individual, project-by-project basis in order to create an architectural repository so that the results of project work build up gradually into a full EA.

However, this viewpoint was not without its detractors. The Infosys consultant, who was brought in to provide an 'expert practitioner' viewpoint, took the view that it is essential to begin the EA process by undertaking a high level, if lightweight, architectural overview of the entire organisation.

One point that did seem to get common agreement was to start EA work by focusing on 'central' processes that everyone uses, most likely key administrative systems such as Human Resources and Accounts. This was partly a pragmatic decision that came out of the rejection of areas such as teaching and learning where it was generally felt that there was so much diversity, for example in pedagogy models, that getting a consensus that could be acted upon would be difficult.

This fits with the ideas of Ross *et al.* (2006) who discuss architecting the "core operating model". They found that the most effective organisations had a clear model of day-to-day operations and what they essentially argue is that without such a model of core processes, new initiatives and strategies become even harder to implement. Their argument is that EA should therefore reflect the integration and standardisation requirements of the organisation's operating model so that running the model effectively, through ICT, provides a firm basis and frees up resources for innovation and new strategic directions.

### **3.2 Governance, leadership, and institutional 'EA readiness'**

Much of the literature and anecdotal evidence from the commercial world indicates that the kind of business change that EA sets out to generate can only happen when senior management are fully engaged with EA work and are driving it from the top. However, this type of approach does not sit easily within the often highly decentralised HE environment. Indeed, there is often a cultural tension in HEIs between top-down and bottom-up that does not exist in industry to anything like the same extent and this poses a particular challenge to the implementation of EA in HE. This issue should be considered

separately to scope as even if EA is only applied to a department it could still be carried out as a top-down process.

Indeed, within the project meeting debates, there was support for 'guerrilla' action on the part of staff lower down the system who could get EA work moving without waiting for decisions from what were perceived as overly bureaucratic committee structures. Deeper discussion of these problems drew out a few important, related issues: a lack of understanding about EA amongst senior management (i.e. a lack of appreciation of EA as a process for change management rather than an ICT issue), shortcomings in terms of being able to identify and exploit the full strategic potential of technology, and the existence of a plethora of strategic initiatives competing for management time (sometimes referred to as 'initiative overload').

An adjunct to this discussion is the issue of governance, a term used to cover a variety of activities concerned with the management and direction of IT and business processes. Governance is of growing concern to senior management in universities and was identified by UCISA as one of a small number of 'top concerns' in 2006/7 and 2008/9 surveys (Cooper, 2009). Related to this is programme and project management across the institution and techniques such as Project, Programme and Portfolio Management (or P3M for short).

In terms of the Pilot, LJMU had invested heavily in refining its governance structures and processes for ICT project work before attempting EA, and this was generally seen as having created a firm foundation for EA work, for example, by exposing duplication and overlap. It was felt that due to the complexity of HEIs there may sometimes be a danger that an institution could take years to sort out governance and that having been through a formal governance review, LJMU had inched a step closer to being well positioned to undertake EA.

LJMU had also invested considerable management time in developing a long-term strategic vision and this prompted conjecture that management 'buy-in' was more important than establishing good governance. Whilst there wasn't much support for this view, the argument is presented here for completeness and it may be useful for JISC to be aware of this line of thinking in future projects.

### **3.3 The Pilot projects in the EA context**

The three Pilot projects took different approaches to the introduction of EA and their respective institutions provided differing strategic and business contexts in which the evaluation took place. They also had a different background awareness of EA and experience of related issues such as IT governance. Cardiff wanted to explore the applicability of EA and TOGAF within a context of developing a service-oriented IT infrastructure that could support LEAN systems thinking across the institution. King's had a programme of work to develop e-research systems that would cut across departments, faculties and administrative units within an already federated infrastructure. LJMU wished to align business process and IT better and develop systems that were more agile. Full details are provided in the case studies in the TechWatch Early Adopter Study (TechWatch, 2009), but in summary:

#### **3.3.1 Cardiff University**

Cardiff's project, LeanEA, provided an example of a more traditional, decentralised

university environment. The Pilot took place in the strategic context of an institution-wide focus on developing a new e-enabled working environment and adoption of software services. As part of this an ambitious new ICT infrastructure environment is being developed, known as the Modern Working Environment (MWE), and the JISC Pilot took place as part of this work. It was initially envisaged that governance would be provided as part of MWE's management structures although that changed fairly early on.

The original aims of the LeanEA project were to apply a range of methodologies for process improvement, including TOGAF, LEAN thinking and Soft Systems Methodology, and to document their impact on defining a service-oriented approach and EA at Cardiff University. The intention was to review both TOGAF and Soft Systems Methodology and compare and contrast their potential costs and benefits but due to time constraints this wide-ranging evaluation was restricted to a review of TOGAF, specifically to look at it in the context of a small number of administrative processes. Cardiff had some prior experience of EA through a project looking at the applicability of the Zachman framework.

Summary characteristics: decentralized environment; bottom-up approach; some prior (but unsuccessful) experience of EA (Zachman); limited scope (but plans to widen)

### **3.3.2 King's College London**

King's College provided an example of a heavily decentralised and federated university structure, commonplace in some of the older universities. The King's pilot project, KEAP, took place in the overall strategic context of a move towards a new e-enabled working environment for the university, known as the Connected Campus. More specifically, the KEAP project was carried out within the Centre for e-Research (CeRch) and focused on evaluating EA and TOGAF within the context of e-research and the development of a Virtual Research Environment.

Staff at the centre had decided that delivery of e-research in a decentralized environment would require a services-based approach and, although they initially knew little in detail, reasoned that EA might help in this process. KEAP eventually focused its work on the processes involved in the administration of research grants. The subsequent pilot work was carried out at the level of the Centre and did not involve the wider institution. KEAP thus evaluated the use of TOGAF in the context of the research domain and the project took a 'bottom-up' approach, rather than being driven from senior management level.

Summary characteristics: decentralised environment; bottom-up approach; no previous experience of EA; limited scope

### **3.3.3 Liverpool John Moores University (LJMU)**

The staff at LJMU took a different course to King's and Cardiff, approaching EA with a top-down perspective driven by the highest levels of senior management, with full support from the Information Management Steering Group – the senior IT governance group chaired by the PVC (Finance and Planning) – and adopting an institution-wide approach. LJMU is a newer university (one of the post-92 cohort) and has a more centralised management structure than the other Pilot institutions. It had for some time been trying to align business processes and ICT more tightly and there had been a number of strategic management initiatives and projects. The university had developed a considerable body of expertise in the area of IT Governance, having participated in JISC pilots in both Governance and Programme Management, with all major IS projects having been managed

as part of an integrated programme for a number of years. LJMU's interest in EA sprang out of these initiatives and a desire to effectively deploy new technologies, especially Oracle's SOA-related systems and products. In order to have a project that could be managed within the twelve months of the Pilot, the focus of the evaluation was narrowed to 'Student Recruitment, Development and Support', one of the four core processes identified within LJMU's strategic plan. The project included a strong emphasis on the governance aspects of EA.

Summary characteristics: centralized environment; top-down approach; no prior experience of EA; institution-wide scope (initially); IT governance focus

### **3.3.4 Roehampton University**

Although not part of the original Pilot, Roehampton joined the process towards the latter half of the programme and took part in many of the meetings and online discussions. They provide an example of an institution that is new but which also has a number of traditions, being formed in 2004 from the merger of four well-established colleges with roots in education and teacher training. It describes itself as management-centric and, at the strategic level, staff have a strong interest in exploring EA in relation to institutional change and shared services. To date, Roehampton's work in this area has involved exploring business modelling tools within an EA framework and how to deliver software services, an Enterprise Service Bus and SOA. They have had a particular interest in learning about and using EA modelling languages. The main vehicle for their explorations has been the CAIRO (Corporate Applications Independence Roehampton) project<sup>5</sup>, which is part of an institution-wide review of the University's administrative processes and supporting business systems architectures.

### **3.4 EA conclusions and analysis**

One of the very first learning points for the projects was that the 12-month timescale of the Pilot was not sufficient to evaluate EA at the scale to which the project work had been conceived. This meant that the scope of each project had to be reduced and that project teams had to evaluate what could be achieved in the time available rather than what they would have liked to achieve in order to evaluate EA fully.

However, programme difficulties notwithstanding, one of the main learning outcomes to emerge from the Pilot programme was the critical need for senior management to be involved in the championing of architectural work, for several reasons:

- Aligning the business goals, strategy and vision aspects of EA that form part of the 'to be' parts of an architecture needs the close involvement of key organisational decision makers.
- EA is more of a process than a product and requires the commitment of the whole organisation.
- EA requires excellent communication between groups of staff operating in different parts of the organisation and this needs a 'whole view' perspective.

#### **3.4.1 Communication**

There was a consensus on the need to continually be aware of the manner in which EA is communicated and 'demystified' for the general audience across the institution. One

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<sup>5</sup> See: [www.roehampton.ac.uk/cairo/](http://www.roehampton.ac.uk/cairo/)

estimate was that the role of an architect is 70% communication and one of the conclusions that several project staff came to is that it is crucial not to underestimate the need for, and scale of, internal communication about EA work, its benefits and progress. Language is important in this context: not only is it not helpful to describe the technical details of EA, a number of project staff felt that the overuse of complex 'box and arrow' diagrams did not help with communication.

### **3.4.2 The 'institution as continuum' and the question of scope**

The 'cut-down' nature of the projects meant that debates over whether to attempt to map the whole institution or just a part of it, were moot. In addition, the early stage nature of the Pilot projects meant that institutional resources available for undertaking EA were limited and a pragmatic approach emerged that focused on finding a 'burning platform' – a critical problem that would act as a demonstrator for the power of EA to facilitate change, as well as generating an appetite for more of the same.

In fact, this pragmatic approach to EA is not dissimilar at a conceptual level to the 'table top and legs' approach to the Institutional Architecture model outlined by Bill Olivier (2009, section 3.3). Adapting this model for EA there would be a 'thin but broad' map of the whole institution (the 'table top'), essentially a rough 'first pass' as advocated by the Infosys consultant. This would then be added to by individual EA projects which, when completed, would provide an up-to-date and 'deeper' view of a small section of the overall map (the table's 'legs'). Over time more and more 'legs' are added to the table top, fleshing out the architecture.

The implication of this is that, to a large degree, questions of scope become moot. In this model the projects, all at different stages of completeness, will emerge as the change drivers and the table top becomes a glass table top – a perspective or view of the institution as a continuum of change. This would seem to fit with the experience of the Dutch universities, who argued for a 'think global, act local' approach, and the Pilot projects, with LJMU in particular arguing that every new IS and business project should in some way contribute to the developing EA. This does, however, raise the issue of EA-readiness. Institutions trying to implement this approach without adequate preparation in terms of management processes and governance run the risk of compromising EA's chances of being successful.

### **3.4.3 Governance**

Whilst scepticism of industry 'governance platforms' is high within HE (Cooper, 2009), the outcome of the Pilot programme is that there is undoubtedly a need for good governance. Whilst the Pilot was inconclusive as to how that might be translated into action we propose that there is value in looking at how institutional governance could be evaluated in terms of EA readiness and linked into the EA evolutionary model (see section 6.5).

## 4. EA Tools

One of the major areas of interest to the Pilot projects was specialist computer-based tools for developing and maintaining enterprise architectures. At the beginning of the Pilot, the projects already had many examples of architecture-related material such as business process models. These had been developed using a variety of existing tools including OmniGraffle, Visio, Intalio|BPM and Triaster, and various UML modellers. However, while these tools are usually sufficient to get an EA project started and undertake basic communication about the organisation's developing architecture, consistency rapidly becomes an issue, with, for example, problems arising when multiple diagrams containing the same architectural element or artefact have to be redrawn individually when that element changes.

Although the Pilot projects realised that learning a new tool would take time and effort, they also recognised that the integration and consistency capabilities of specialist tools would generate long-term benefits. It was also felt that a shared involvement in looking at tools and their applicability would help bind the process of evaluating EA, partly by providing a kind of common language for discussing processes. Some of the advantages of specialist tools put forward by the projects were:

- automatic generation of different views of the underlying architecture, which can be visualised and presented to different stakeholders for review and analysis
- capability to handle different architectural domains and the relations between them in a single tool (e.g. business process material can be handled in the same tool as information about an institution's application infrastructure)
- support for consistency checking across the different aspects of the architectural model
- standardisation of architectural practice across the institution (i.e. where a single EA tool is used)
- support for impact-of-change analysis, quantitative analysis of EA models and comparison of the 'as is' and 'to be' scenarios.

Selecting a suitable tool is another matter. It was clear from conferences that different tools have their fan base within different segments of The Open Group, but this is also a rapidly evolving market with the Institute For Enterprise Architecture Developments listing over 30 suppliers of tools, some of which provide more than one solution (Schekkerman, 2009). A particular issue with the EA tools market is that a number of vendors brand their products as EA when in fact they are more closely associated with business process management and software engineering and often, existing tools have simply been adapted (ter Doest et al., 2005).

Gartner provide a regular summary of the EA tools market in their Magic Quadrant report series and argue that the minimum requirements for such tools (and their basic criteria for inclusion of a tool in the market review) are (James and Handler, 2006):

- a repository
- a metamodel that supports different architectural viewpoints as well as relationships among and between objects and assets in the architecture
- ability to create, import and export models and artefacts

- ability to extract information from the repository for use by stakeholders in various forms (e.g. graphical, text, executable).

A number of other ICT market analysis and research organisations provide similar reviews of the market including The Forrester Wave™ Enterprise Architecture Tools review, Burton Group and Infosys. Leading tools being used by companies in Infosys's (2007) survey included Telelogic System Architect (now IBM Rational System Architect), Troux, Framework, IDS/Oracle ARIS, Proforma (now part of Metastorm) and Casewise. During the Pilot attention turned to the merits of Telelogic System Architect, (which is being used by Salford University), Sparx Enterprise Architect (which is being used by the Max Plank Digital Library), Alfabet's planningIT, Oracle's business process tools, and Orbus. However, later discussions began to centre on BiZZdesign Architect, a spin-off from the Dutch Telematica Instituut, and used quite widely in Dutch higher education institutions.

BiZZdesign Architect was first raised as a potential solution during a group visit to The Open Group conference in Glasgow in April 2008, partly because it had come top in a survey of EA tools carried out by SURF. Later in the year, BiZZdesign presented their solution at one of the Pilot programme meetings and a number of the project staff downloaded and trialled the software. In addition to the attractiveness of using a product that had had some exposure in the Dutch HE system, BiZZdesign's tool had the added bonus of supporting the *ArchiMate*® metamodel language (see below). Due to the time constraints of the Pilot programme it was decided in June 2008 that all the projects would make use of the BiZZdesign tool, even though a detailed and formal evaluation of other tools had not taken place. JISC assisted with the costs of licensing and training.

Cardiff however, retained an interest in continuing to explore Telelogic, in large part because IBM had acquired the software and Cardiff has a strong partnership with the company. An outstanding issue is that Telelogic has an additional module to provide ArchiMate, but this is not, at the time of writing, formally supported by the company.

#### **4.1 ArchiMate**

The evaluation of EA tools during the Pilot became closely entwined with discussion about ArchiMate, a language for describing and exchanging information about EA. Such languages are sometimes referred to as meta-models or meta-languages and have the benefit of aiding communication between stakeholders who work in different parts of an organisation or who operate within a specific architectural domain (for example, spend their time developing business process models). In some senses it can be regarded as a bridge between such different domains, for example between the worlds of UML and BPM. Further introductory details are provided in TechWatch (2009) and Lankhorst (2004).

There was considerable interest in ArchiMate during the Pilot. This was in part driven by the knowledge that it had been adopted by Dutch universities, with SURF noting that they have worked hard to ensure that universities involved in architecture work in the Netherlands use a common language for communication, with ArchiMate as their language of choice. In addition, a recent report by JISC CETIS outlined the need for a common, high level language for communicating an integrated view of modelling work, and detailed the requirements that such a language would need. The report concluded that, to date, the only language that fulfills these requirements is ArchiMate (Olivier, 2009 – section 3.2).

Indeed, while TOGAF itself is neutral to the choice of tool, in the latter stages of the Pilot The Open Group announced that it has adopted ArchiMate for standardisation and it is therefore likely that there will be some form of certification for tools that claim to support it<sup>6</sup>. In the meantime, the following tools have been certified by the ArchiMate Foundation as offering support for the language: BiZZdesign Architect, Aris, Metis, Casewise and Telelogic.

#### **4.2 EA Tools conclusions and analysis**

The immediate outcome of the Pilot is that Cardiff will continue to explore Telelogic whilst the other projects have obtained BiZZdesign Architect and are continuing to make use of it for the time being. At a more strategic level, JISC is keen to see wider adoption of ArchiMate within tertiary education as it is an open standard and will facilitate non-proprietary exchange of EA information between different institutions and this may put additional pressure on vendors to extend their toolsets. Certainly, one of the arguments for HE to adopt ArchiMate now is the opportunity to get involved in its development and be influential from an early stage. In light of how little research and testing of tools took place in the Pilot programme it was suggested JISC could facilitate a more in-depth and considered analysis of those tools that support ArchiMate. Recommendations for this further work are included in section 8.

Although there was not complete unanimity on what tools to recommend, the majority view was to make use of ArchiMate through the templates provided for Visio or Omnigraffle before investing in a specialist tool. However, it is worth noting that this was at odds with the recommendation of the Infosys EA consultant, who had many years of experience of developing architectures for large companies. She argued unequivocally for the use of a specialist tool right from the outset as the use of a central repository and the ability to link together different assets is important even at an early stage. We account for this difference in perspective as being an indication of the distinction between the 'learner' and 'expert' views of the world. In the 'learner' view, early stage experimentation is more important than 'getting it right'. For the expert, achieving the task is the main priority and making mistakes becomes a cost rather than an acceptable learning curve. In this scenario, having specialist tools is a priority.

In fact, the issues around the choice of tools are probably not that straightforward. It is easy to construct an argument that justifies not using specialist tools: they're expensive, there's a learning curve and training will be required, and, ultimately, people like to stick with what they know. Indeed, research from Infosys (2007) shows that "only one third of all EA teams are using commercial EA modelling tools. Others are relying on office tools like Microsoft Word and Powerpoint, or simple drawing tools like Microsoft Visio" (p.20). This was backed up by observations from a Gartner webinar that were posted to the Enterprise-Architectures list hosted by JISCmail – currently the main forum for debate about EA in UK HE – which reported that most organisations do not use sophisticated modelling tools, with Visio and Powerpoint the most popular.

In terms of joined up thinking it could pose significant problems if HE is allowed to go down this route. The absolute need for interoperability and re-use that is central HE's vision for cross-sector co-operation requires that decisions around tools are made with this big picture vision in mind. With this in mind we propose that tools should become an

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<sup>6</sup> A forum has been created at: <http://www.opengroup.org/archimate/what-we-do.htm>

aspect of EA readiness within the developing evolutionary model (see section 6.5). This might mean, for example, that institutions using basic tools such as Visio would be classed as 'Explorer' and adoption of a specialised tool would serve as an indicator that an institution had moved to the 'Adopter' level. If appropriate, this could also be linked to funding criteria, with grants for 'EA ready' institutions reserved for those that can demonstrate a commitment to a suitable tool and therefore a commitment to EA.

## 5. TOGAF and The Open Group

TOGAF is a global, consensus-based, non-proprietary, standardised framework that helps organisations develop an EA. It is licensed free of charge for 'internal' purposes, but if it is used as part of a business consultation then there are costs to pay and a commercial-use licence. It has been developed by The Open Group, an international, membership-based, vendor-neutral consortium, which aims to provide an independent forum for the development and use of a range of ICT-related open standards. Many of the overall goals of The Open Group offer potential synergies with JISC's role of guiding the development of technology and standards within HE/FE, in particular, The Open Group's method of working through federated fora of interested parties.

The key component of TOGAF is the ADM, a methodology that provides a step-by-step process for developing EA. The Pilot projects used TOGAF version 8.1 although since the Pilot ended there has been a new release and TOGAF currently stands at version 9. This more recent version introduces a number of changes and, in particular, attempts to increase usability and provide additional help with the process of EA. A modular structure has been added and there is additional material on working with SOA. A major addition is the Content Framework which aims to provide architects with a meta-model or kind of map of what information they need to gather and analyse. Whilst EA work in HE subsequent to the Pilot will no doubt report back on these improvements, observations and evaluation presented in this report are based on version 8.1.

### 5.1 Evaluating TOGAF

As part of the Pilot programme, project staff were provided with membership of The Open Group in order to access members-only areas of the Group's website and attend conferences in Glasgow and Munich. Each project evaluated TOGAF based on their own experiences in their institutional context and more information about this is available in the Early Adopter Study (TechWatch, 2009).

#### 5.1.1 Complexity versus flexibility

At the beginning of the Pilot programme, the overall view of TOGAF was that it was extremely comprehensive and, at first viewing at least, large and quite daunting (the accompanying Open Group book, for example, runs to some five hundred pages). The teams quickly found out that TOGAF is a generic method for carrying out architectural work and there was some initial confusion as there had been expectations of a more formalised, step-by-step process to be followed.

Opinion was somewhat divided over the extent of TOGAF's generic nature. Some felt that the flexibility afforded by TOGAF was beneficial, others worried that there was just too much flexibility, with too many optional elements. The Open Group argue that this is a strength of this particular framework: it is sufficiently flexible to be able to incorporate other techniques and methods, even other frameworks such as Zachman. Cardiff in particular were pleased that TOGAF's generic nature meant that they could accommodate other techniques such as LEAN thinking and the Soft Systems method (both of which TOGAF can absorb at the Business Architecture phase), whereas others were concerned that it is so generic that it merely provided a 'glorified checklist' of existing architecture and systems infrastructure. This led on to a discussion of the dangers of 'retrofitting' TOGAF – where existing architecture work is merely fitted into the TOGAF framework, which would discourage people from exploring the 'to be' side of EA.

From a practitioner's perspective, LJMU noted a similarity with PRINCE 2 and advocated an approach whereby organisations choose which elements to make detailed use of. Like Cardiff, LJMU were also interested in incorporating other techniques, for example DYA, into their work.

However, for completeness on this point, John Callery, Chief Enterprise Architect at DCSF where the most in-depth work on public sector EA has been taking place, was adamant that incorporating other techniques in this way is very difficult unless staff have considerable experience of EA work. There was universal agreement that to be more sure about this there needs to be a longer period of study, in which full cycles of the ADM are carried out in a HE setting.

### **5.1.2 Getting round the ADM**

Also in the early phases of the pilot, the individual project teams struggled to grasp exactly how to go about implementing the ADM. There were a number of reasons put forward in early discussions:

- lack of worked-up examples and case studies in the TOGAF material provided in the training workshop (ameliorated by TOGAF version 9)
- size and complexity of accompanying documentation
- confusion over where exactly to start
- lack of clarity as to the order of steps in the ADM and number of iterations required.

In fact, as the Pilot programme advanced and familiarity with the ADM increased, these concerns abated. Later on, one of the ideas put forward as a way of dealing with TOGAF's complexity was to concentrate on certain phases of the ADM and this was the approach adopted by some projects. LJMU concluded that they would probably use ADM up until Phase D – when it hands over to implementation – rather than the full process.

### **5.1.3 Membership of The Open Group.**

There was some early scepticism from individual project members as to the potential benefits that membership of The Open Group would provide and concerns were raised about the costs involved. One of the early learning points from the projects was that the main benefit of membership is the opportunity to participate in the online fora. However, as much of The Open Group's focus is on the creation and further development of the TOGAF standard rather than helping organisations actually make use of it, participation in fora did not provide much benefit to project staff. Some of these concerns were mitigated following the second conference in Munich, where a track aimed specifically at Higher Education was introduced and the preliminary meeting of a nascent education forum took place<sup>7</sup>.

## **5.2 TOGAF conclusions and analysis**

One of the questions that the Pilot programme set out to answer was whether or not TOGAF was suitable for 'doing EA' within UK HEIs. Whilst this question remains unanswered, and the debate around complexity versus flexibility rages on, there perhaps needs to be some consideration of the alternatives and their suitability: TOGAF, for example, is the only framework that mandates the use of 'open' standards (although this, in

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<sup>7</sup> This is now going ahead as the Enterprise Architecture Practice Group – see section 6.5

itself, is not straightforward). Also, how much of the problem associated with TOGAF's complexity might appear, with the benefit of hindsight, to be just a natural part of the learning curve? Whilst a less complex framework might make things easier in the beginning, would HE's "DIY" culture (see section 7.2) result in a scenario where a simpler EA framework is rejected further on down the line as 'too simplistic', or 'not flexible enough'. Is it just a fact of life that staff in universities like to be able to engage and adapt – something that TOGAF is structurally conducive to.

Having said this, one conclusion from the projects was that, given its generic nature, there needs to be serious consideration of the specific ways in which HE might use TOGAF in order for it to be of real benefit to the sector. Indeed, the TOGAF documentation talks about organisations reviewing which parts of the framework they can make use of and developing "an enterprise-specific ADM" (Open Group, p.56). However, it is again important to note that John Callery from DCSF was adamant that this is no mean feat and should not be attempted without significant resources and expertise. As work is continuing with TOGAF, consideration of just how it can be used within HE should be incorporated into this further work.

In addition, consideration should also be given to how TOGAF is introduced to HE staff, with some aspects (e.g. worked examples) requiring HE-specific material for inclusion in training workshops. In addition, some of the problems experienced early on in the Pilot programme are likely to be just normal steps on the learning curve and are therefore likely to arise when other HE project teams begin to engage with TOGAF. There are therefore some learning points, gleaned from a further training session with a consultant from Infosys Ltd, that should be taken forward into future JISC projects:

- avoid 'analysis paralysis' – there is a certain amount of 'learning by doing' involved in using TOGAF and project teams should not overly worry about getting it catastrophically wrong
- select somewhere to start and get going
- develop a basic skeleton of the architecture before filling in too much detail (it is commonplace for beginners to try to put in too much detail)
- avoid the temptation to try and fully complete each step of the ADM before starting other ones
- make use of a standards-compliant and suitable tool (see section 4)
- realise that TOGAF can be adapted to fit the specific situation within an organisation.

Specific benefits from using TOGAF were described as:

- communication and governance-related benefits of having a structured method in place for architectural work. Conflicts between stakeholders will inevitably arise and TOGAF, to a degree, offers a way of reaching a compromise across the institution.
- a focus on the requirements of users and stakeholders, by, for example, placing this at the centre of its framework model, which helps to enable communication across the campus. These user requirements tend to have a permanence over and above technical solutions and allow some continuity.
- architectural principles and attendant templates provided by TOGAF were very useful. The templates provided in the documentation forced projects to express and

communicate the rationale behind institutional business and technology decisions at a high level.

A final observation is that there was considerable interest from existing Open Group members as to the progress of the Pilot and, in particular, curiosity as to the open manner in which the EA work was being undertaken. The Open Group are keen to develop their links with UK HE and the tertiary education sector is seen as a new 'vertical' which is going through the 'teething troubles' of starting to adopt EA. It is thought that the open way in which HE works will have considerable benefits for others and there is considerable interest within The Open Group as to how higher education might approach TOGAF. The development of HE case studies is of particular interest as these are in short supply from Open Group members due to the perceived commercial sensitivity of the information that would need to be provided.

This highlights one of the differences between the industry approach and the HE approach: the open way in which the Pilot projects have trialled TOGAF and recorded their findings means that its results are freely available to benefit other HEIs. The co-operative nature of HE means that there has been an opportunity to develop a 'peer-to-peer' way of learning about EA that could be significant for the development of the shared services agenda.

## **6. Summary of Impact**

The Pilot programme was completed in April 2009. At a final meeting each of the projects was asked to sum up their experiences and outline where they were with regard to the adoption of EA and TOGAF. All of the institutions were continuing with EA work and several had decided to continue to use TOGAF by making use of parts of it. There were still some concerns and unresolved issues over where exactly TOGAF should fit in the armoury of senior decision makers and how it relates to things like the overall business vision and context of business change. Such issues, which in part refer to an institution's readiness or maturity for architecture work, may need further investigation and clarification.

### **6.1 Cardiff University**

At the beginning of the Pilot Cardiff's vision was big and bold, and although they had been unsuccessful with earlier EA work using the Zachman framework, they believed that the JISC Pilot offered them a second chance to acquaint the university with architectural techniques. Although the project had to be reduced in scope to match the Pilot programme's timeline, the project staff believe the process has been beneficial and that the Pilot has raised awareness of EA across the university. They note tangible benefits including work that has taken place to map out maturity and gap analysis and argue that their experience reveals that there are many established EA-related practices across the university that can be mapped to component areas of TOGAF. Although these areas would benefit from being joined up more effectively, there is a clear role for EA in this regard. As they note in their case study: "The effort spent trying to understand and apply TOGAF has helped us identify and clarify some fundamental organisational issues and challenges."

The Cardiff team retain a strong interest in EA, are continuing to develop 'as is' models at the micro-level for 'burning platform' issues and plan to look in more depth at Maturity/Capability modelling and how it relates to EA. The work of the LEAN programme continues at the university, with a focus on Human Resources, and there is a general feeling that the Pilot project has helped bring the LEAN work a little closer to other, ICT-related work. Cardiff staff are currently using IBM's System Architect tool, but have not committed to its long-term use and are still keen to analyse tools.

### **6.2 Liverpool John Moores University**

LJMU fully intends to proceed with EA-related work across the institution and is embedding an architectural approach in all major IS projects, and in IS strategy development, with the full supported of the Information Management Steering Group. They will continue to make use of BiZZdesign and their next major initiative involves a move to Oracle Campus Solutions. LJMU are positive about their experiences on the Pilot programme and believe that it has helped to kick-start EA work across the campus. The project team believe there has been a definite change within LJMU, that the 'landscape' is changing and that people within senior management who would not have been thinking about EA 18 months ago are now engaged.

They also believe that the focus on EA and governance will help reduce duplication of services and costs in the next few years, with a reduction in the commissioning of small, 'one-off' applications to solve one department's particular problem, already reduced. This is promoting a more holistic view of systems and services, something the team refer to as 'internal shared services'.

Whilst TOGAF provided a very useful framework for the original Pilot, and is still a useful reference model, LJMU have effectively adapted the ADM to focus EA within the individual projects in terms of 'as is' and 'to be' architecture modelling, as other parts of the ADM are covered by other methods already in use.

### **6.3 King's College London**

There have been a number of internal changes at King's which have meant that the College's VRE project is not going ahead as it had been originally envisaged. However, EA work will continue to be explored within CeRch through the EU project DARIAH, which aims to conceptualise and subsequently build a distributed research infrastructure for the arts and humanities across Europe. The Centre will make use of the Archimate modelling language for enterprise architecture, supported by the BiZZdesign Architect tool, in this project. It was considered that this concrete standard would be more useful for this work than the rather broad and generic TOGAF.

For King's, although the immediate future for EA work within the College is perhaps less clear, there were still a number of benefits from taking part in the Pilot including the uncovering, via process mapping, of duplication in administrative functions. Through CeRch, King's will be participating in JISC's FSD programme, with a focus on e-research services.

### **6.4 Roehampton**

Finally, for Roehampton, who came to the project late in the day, there have been enormous benefits. Even their brief involvement with the Pilot has allowed a wider recognition of the information systems problems that they face and a real recognition that information should be seen as an 'asset'. The EA work has helped senior managers see data in the context of the whole university and they remain committed to driving the work forward through the CAIRO project. Roehampton plans to continue to use TOGAF and the BiZZdesign toolset.

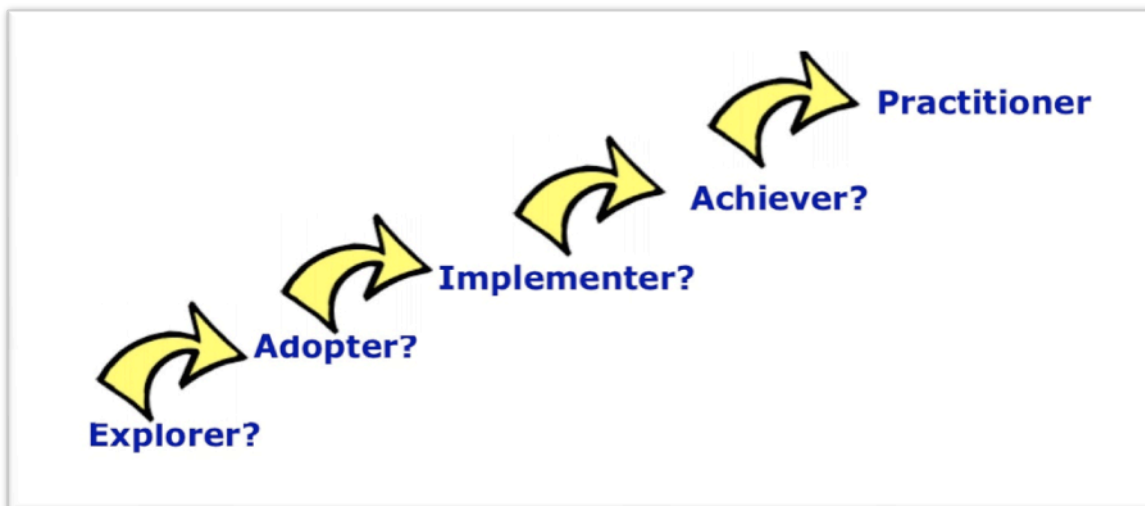
### **6.5 JISC**

JISC recently joined The Open Group as a 'Gold' member, reflecting a general conclusion that whole-sector involvement through JISC was more important than individual HEI membership. JISC is keen to continue to develop these links, in part because the organisational goals are a close match, but also for the opportunity to learn from the commercial sector, which, in the case of EA, is further along the innovation curve.

In addition, JISC has been maintaining close links with the university sector in the Netherlands, through SURF, as institutions there have already embarked on the EA journey and undertaken a number of projects. There has been discussion of some form of study tour of the Dutch universities that have undertaken this work.

Finally, towards the end of the Pilot, discussions started to emerge about formal Architecture Maturity Models. Capability Maturity Models (CMMs), for example CMMI, have been in use for a number of years to measure and benchmark an organisation's progress in IT-related areas and to provide frameworks for monitoring improvement. These models have recently begun to incorporate the ideas of EA, with, for example, the

US Department of Commerce's *IT Architecture Capability Maturity Model*<sup>8</sup> and The Institute for Enterprise Architecture Developments' *Extended Enterprise Architecture Maturity Model (E2AMM)*<sup>9</sup>. It was noted that work has already begun on maturity models for SOA within HE (Cooper, 2009) and that as part of the support work for the Pilot project, JISC staff and consultants have started to develop an 'evolutionary model' for HE-related EA (Figure 1):



**Figure 1: EA in HE evolutionary model**

This model focuses on a six-stage journey as follows:

1. Darkness	No knowledge or awareness of EA, or resistant to the idea
2. Explorer	Has decided to research/investigate EA and develop a case
3. Adopter	Has decided to go ahead and is planning/orientating/getting ready
4. Implementer	Initial projects, training and work under way
5. Achiever	First project results and business impact demonstrated
6. Practitioner	EA has become a regular part of strategic change and development

Finally, the work of the JISC Pilot has recently transferred to the JISC Organisational Support (JOS) Committee and will be driven forward through the Flexible Services Delivery (FSD) programme, which launches in Summer 2009. Work on an 'evolutionary model' for HE is likely to be developed further as part of the FSD and an Enterprise Architecture Practice Group will be established with representatives from a range of UK HEIs as well as expertise from the Open Group, JISC and SURF. Its mission:

*"To enable champions in higher education to use the Enterprise Architecture approach in infrastructure and operations innovation, through sharing knowledge, experience, tools, problem solving support and collaboration."*

Finally, it is important to mention that the Pilot project work has not taken place in

<sup>8</sup> Further discussion at: [http://www.opengroup.org/architecture/togaf8-doc/arch/chap27.html#tag\\_28](http://www.opengroup.org/architecture/togaf8-doc/arch/chap27.html#tag_28)

<sup>9</sup> <http://www.enterprise-architecture.info/Images/E2AF/E2AMMv2.PDF>

isolation. It should be noted that there is related work taking place within JISC and in associated/partner organisations. This includes:

- The Higher Education Academy and its Change agenda<sup>10</sup>
- High Level Domain Architecture mapping (HiLDA) project<sup>11</sup>
- UCISA
- E-Framework and JISC Community Engagement Team (CET)
- JISC-funded Information Systems Management & Governance Project (ISMG<sup>12</sup>)
- CETIS SOA Pack<sup>13</sup>
- BCS Architecture Group<sup>14</sup>
- ITANA – IT Architects in Academia<sup>15</sup>
- Journal of Enterprise Architecture<sup>16</sup>

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<sup>10</sup> <http://www.heacademy.ac.uk/ourwork/institutions/change>

<sup>11</sup> <https://pims.jisc.ac.uk/projects/view/693>

<sup>12</sup> <http://www.ismg.ac.uk/>

<sup>13</sup> <http://soa.cetis.ac.uk/soa-pack/resources/soa-pack-briefing-2>

<sup>14</sup> <http://www.ea.bcs.org/content/index.php>

<sup>15</sup> <http://www.itana.org/>

<sup>16</sup> <http://www.aejournal.org/>

## **7. Is HE a 'special case'?**

One of the questions that the Pilot programme set out to investigate is to what extent HE is different to industry and whether or not those differences make it a 'special case' in terms of EA. Points made here are again summaries of discussions that took place during the Pilot programme.

### **7.1 Initiative overload and seeing the bigger picture**

Throughout the Pilot programme, one particular concern has been whether or not HE as a sector is ready to listen to the benefits of EA. Various project staff expressed concern that senior management are worried about a general 'initiative overload' and EA would simply be one more acronym to deal with. Related to this were concerns about the naturally conservative nature of universities, which find institutional change difficult. This can lead to problems over getting decisions on and articulating the 'to be', big picture vision. Also, TOGAF assumes that some of the key strategic and business vision cornerstones are in place prior to inception of an EA programme and sometimes this is not the case in HE.

### **7.2 Doing EA in HE**

A new way of actually doing EA may need to be explored for the university sector. The general impression that the staff in the pilots garnered about how this type of work is carried out in the commercial sector is that there is a great reliance on management consultants and third parties. Previous experience amongst project staff seemed to concur that, overall, HE as a sector has found it difficult to integrate consultants more used to working in industry. One factor is the language, which is of the commercial sector and "management consultancy-speak" but there was also a general opinion that the HE way was far more "DIY", with learning between peers in different institutions over a period of time, rather than using consultants.

The consensus was that while there would always be individual exceptions, it would be difficult to find sufficient numbers of third party EA consultants who would thrive in HE environments. There was widespread support for the idea that JISC should therefore work to train up mentors who have HE experience and can be embedded with projects as and when required.

### **7.3 Peer-to-peer EA**

It was pointed out that in reality EA work in HE is likely to be undertaken by an amalgam of people with different skills brought together from across the campus, rather than a single person or small team, as it is unlikely that there will be resources for such a dedicated role(s). However, by the end of the Pilot at least one institution had begun to 'wonder out loud' about the possible recruitment of a Chief Architect, so this may change over time.

Project members were very aware that they were pioneering EA in the sector and that there was little, if any, existing knowledge or personnel that they would be able to draw on. However, the generally open and co-operative nature of HE means that it doesn't have to be this way for future projects and there was support for the opportunity to develop a peer-to-peer way of learning about EA. One of the achievements of the Pilot is the beginning of an inter-institutional pool of people with a developing interest and knowledge of EA.

### **7.4 Training**

A clearly related issue is the matter of training provision for staff who are working in EA.

There can be a substantial learning curve to this kind of work, particularly when a new, specialist tool is being introduced, and there is sometimes a temptation to use system designers and analysts to undertake EA work rather than qualified architects who have the necessary training, certification and experience. There was some debate as to whether JISC should be actively helping with the training of architects in the sector. There needs to be further evaluation of these needs.

Of particular importance is the use of worked examples and case studies. These are currently lacking, due in part to the commercial nature of much of the work. The Open Group is aware of this and is keen for HE as a sector to help in this regard.

### **7.5 Identifying Stakeholders**

There was general consensus that identifying stakeholders is of primary importance to the start-up of EA. Identifying key actors and decision makers has been shown to generate debate within an institution and this is clearly one of the benefits of embarking on EA work. However, a particular problem is that some roles within universities vary so widely. What can we say is a researcher? Many participants thought it was important to focus less on labels within organisations, since roles and responsibilities do not always follow the label, and to look more carefully at who makes what decisions.

### **7.6 Developing a Reference Model**

Such discussions led into a debate about whether the education community should create canonical models and if it should be developing a Business Reference Model for HE. Discussions on this front revolved around whether it is possible to abstract core processes in an education environment. Can the central roles of universities, teaching, learning and research, be formalised? Centralising processes for such activities, particularly teaching, have proved remarkably difficult to enact in the past.

It was felt that HE in general has not been good at thinking about or mapping its own lifecycles of activity and exploring commonalities between institutions. There is obvious overlap here with the shared services agenda and the work of the JISC Innovation Base. Such a generic model, at a high level, might help institutions find a starting place for their own EA work. These discussions led to a comparison of what could be achieved and previous attempts such as the ill-fated MAC initiative. It was felt that there was potential for doing institutional mapping and seeing if some kind of common model(s) emerges, possibly one model for federated HEIs and another for more centralised HEIs.

### **7.7 The role of innovation**

Related to this is the role of innovation. Universities are organisations in which new ideas and technologies are often being developed or experimented with. Individuals in departments are frequently introducing new ways of working, for example, in recent years many staff have made use of Web 2.0 technologies in lots of interesting ways. This is clearly not unique to the university sector, but the scale and decentralised nature of it might be, given that one of the primary roles of the sector is to act as 'ideas communities'. Pilot participants were keen to debate whether and how EA could be dynamic enough to incorporate new developments and 'left-field thinking'.

Inherent in this debate is the tension between EA as a tool for digitising core business processes (Ross *et al.*, 2006), where the 'to be' vision represents an optimised platform for the delivery of key administrative functions, and a wider issue of disruptive innovation that

is more experimental and less able to be planned for. The answer from Ross *et al.* is that EA should reflect the integration and standardisation requirements of the organisation's operating model so that running the model effectively, through ICT, provides a firm basis and frees up resources for innovation and new strategic directions. However, this does not really provide a satisfactory answer and this should be an ongoing question for future EA adopters.

### **7.8 Return on Investment (ROI)**

Senior management rightly question the investment in any new project or initiative, especially in times of developing austerity, and projects need to demonstrate a clear ROI. Although the Pilot demonstrated many benefits from undertaking such work, and project staff were able to give anecdotal evidence of time savings following an administration system change brought about through EA work, by the end of the programme it was still not clear how cost savings could be quantified for an EA project or for TOGAF.

However, since the completion of the Pilot, LJMU have been communicating the benefits of EA through a cost reduction message. By demonstrating how their Oracle CRM could be deployed to provide a Welfare Disability Tracking Service, a Students Complaint Service and (eventually) a Staff Complaints and Grievance Service it was possible to demonstrate that proposed expenditure on a new Welfare Disability system was unnecessary. As well as saving money, demonstrating how existing systems can deliver required services makes the connection between technical systems and business processes transparent.

## 8. Speculations and recommendations: the future of EA in HE

EA work in HE is still at a very early stage and there is no doubt that further work is needed before some of the big questions asked at the beginning of the Pilot programme can begin to be answered. However, there are conclusions that can be drawn from the findings and these have been used here as a starting point to speculating on the wider role of EA in HE.

At the beginning of the Pilot programme, many of the questions hinged around practical considerations such as the size of the undertaking and therefore its feasibility, sometimes described as being like 'trying to boil the ocean'. While answers to some of the questions around scope and senior management buy-in are starting to emerge, there are still some very big questions around vision, leadership and the future that were beyond the practical remit of the Pilot programme. In order to try to address some of the future-facing issues that are likely to have an impact on EA in HE we have returned to two questions that were asked at the beginning of the Pilot programme that relate to the 'to be' part of EA.

- Should an institution start with the 'as is' side of EA or the 'to be'?
- Does HE have the level of business planning and strategic vision required by the 'to be' phases of EA?

It is probably feasible to start by speculating on the second question, due to the generalised concerns that emerged during the Pilot and which are summarised in section 7.1. Also, this report has acknowledged the findings of the JISC report into the integration of technology into institutional strategies (Duke et al., 2008), which noted the shortcomings in the capability of senior management teams to identify and exploit the full strategic potential of technology.

Taken together, the general conclusion seems to be that in general HE does not currently have the understanding of the transformational power of new technology required by the 'to be' phases of EA. However, this is not necessarily a 'deal breaker' for the useful adoption of EA by the sector and EA may even emerge as a kind of 'trojan horse' that forces renewed interest in leadership skills.

In addition, the EA Pilot has not taken place in a vacuum. A number of JISC initiatives such as the FSD Programme, alongside ongoing work by the Leadership Foundation and UCISA, are all raising awareness of the importance of these issues. There are also 'big picture' strategic drivers such as shared services and technical drivers such as Cloud Computing and soa/SOA that point to the direction of travel, and senior managers who act quickly are likely to secure a permanent advantage in terms of their institutions' capability to respond to change in the future.

However, in the near future it is likely that the peer-to-peer model will contribute to delivering this capability. In order to achieve this we suggest that there is value in thinking about Institutional Architectures as a distinct 'flavour' of EA, which involves bringing in a wide variety of people (i.e. from outside IS) as part of this process.

### 8.1 Institutional Architectures

One of the observations to emerge from the Pilot was over the perception of 'enterprise'. Initially this revolved around issues of scope and the word's commercial connotations and

it was suggested that for education perhaps we should talk about 'institutional architectures'<sup>17</sup> instead. However, this goes beyond language. If we agree that EA will need to be adapted for HE then, over time, the concept of IA may emerge as not only a linguistic trick, but also as a subtly different form of EA. How might it be different? As a first step attempt at analysis there could be value in thinking about the HE context and the challenge this throws down, for example, a recognition of the complexity of governance models in some (highly federated) HE environments, and the issues over leadership and the difficulty of getting a long-term, strategic 'to be' vision where there may little understanding of the transformational implications of IT. Secondly, by drawing conclusions from the Pilot projects, there is value in looking at the features that IA may be usefully said to incorporate:

- a mandate to use open standards
- HE-friendly language
- adaptation of TOGAF methodology to HE
- within an institution, less focus on an architectural team, led by a Chief Architect, and more on distributed, cross-campus teams who have been empowered to deliver architectural visions
- between institutions, a peer-to-peer model, facilitated by JISC and other, like-minded organisations, embodying openness, cross-sector learning, skills sharing and transparency (e.g. through case studies).

## 8.2 'As is' or 'to be'?

Finally, there is one question that has not been answered, and that is the question of whether or not an institution should start with the 'as is' or the 'to be'. We would like to suggest that, at least as far as cross-sector work is concerned, it is important that both should be undertaken at the same time<sup>18</sup>.

This report has already discussed how, in general, HE as a sector needs to plan better for the future (see section 1). In fact, even within EA work the emphasis is on 'doing EA' with a view to supporting key administrative functions. While this may be a pragmatic necessity brought about through the need to 'start somewhere' (see section 5.2), there needs to be some attention to embedding forward thinking right from the very beginning and a 'burning platform' for institutional and cross-sector approaches to EA is the 'Green ICT', more often referred to as the 'low carbon', agenda. As Lewis Curtis notes in a recent edition of the *Architecture Journal* (18): "architecture leaders are now proactively considering environmental resource constraints along with more traditional IT business goals" (page 2).

This is an obvious choice for several reasons as it:

- requires institutional buy-in, at the most senior levels, to drive it through
- has strategic overlap with other aspects of EA in HE, e.g. shared services, Cloud Computing etc.

However, we argue that there are even more compelling reasons than this. A significant aspect of the HE low carbon agenda is going to be concerned with re-imagining the use of

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<sup>17</sup> In fact, commercial language can pose a serious barrier to adoption in the HE environment. See, for example, OSS Watch's mini case study on the adoption of a commercial CRM system: <http://www.oss-watch.ac.uk/resources/CRM.xml>

<sup>18</sup> Indeed, one beneficial aspect of TOGAF is that if the ADM is followed as described, there is no concept of only doing 'as is'.

buildings, and this requires forward-thinking and committed Estates managers. Procurement will also become an increasingly important function within universities, where new thinking and innovative practice will become critical over the coming years<sup>19</sup>. Involving staff from these areas in EA work will ensure that a cohort of forward thinking individuals becomes ready to take on roles as change drivers, and also to act as a source of developing expertise that will be able to understand and have ideas about the changes facing the sector.

In fact, the Pilot projects noted the importance of drawing on a wide range of stakeholders, yet those who have been leading it so far have been from IS/technical backgrounds. JISC can set a good example in this respect by involving a wider variety of people in its projects. Suggestions for recommended actions are outlined in the following sub-section.

### 8.3 Recommendations

Recommendations connected to the outcomes of the Pilot programme have been made at the end of each section, over the course of the report. However, we believe that there is also a need for recommendations for future work that draw on a wider perspective from across the sector. With this in mind there are two main recommendations: the first is a detailed recommendation for a large piece of work on tools, and the second is a more speculative suggestion for 'to be' work.

#### **Recommendation 1: JISC should commission an in-depth evaluation of EA tools that are of potential use to HEIs.**

The selection and use of appropriate EA tools has emerged as an important issue, particularly in terms of interoperability. Although there was not sufficient time to conduct an in-depth analysis of tools during the Pilot programme, JISC should commission a more in-depth and considered piece of work on the role and requirements of EA tools to be conducted in two parts. Firstly, this work should develop an analytical framework based on the particular needs of higher education and should assume support of ArchiMate as a main criteria in favour of tools selection<sup>20</sup>. As a minimum, the framework should include functionality, supported EA frameworks (e.g. TOGAF), documentation, training availability, configurability and usability, but should also consider (from the project teams):

**Price structures and licences:** there was some concern as to whether vendors of specialist tools are sufficiently prepared for dealing with the tertiary education sector. There may well be issues with pricing structures and licensing arrangements that warrant further investigation, and possibly collective action through organisations such as JISC or UCISA. Consideration should also be given to the specific requirements of procuring open source EA tools (see below) and evaluation should take place on a 'level playing field' basis with proprietary products<sup>21</sup>. This work could tie in with the work of the Procurement working group (see below).

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<sup>19</sup> More on this will be available in a forthcoming TechWatch report on low carbon ICT.

<sup>20</sup> This report documents the decisions taken during the Pilot programme around tools selection as well as the reasons for those decisions, particularly the use of ArchiMate. However, it is important to note that some institutions already have existing relationships with vendors who also supply EA tools (as we have seen with Cardiff) and it may well be more cost effective for these institutions to use the existing vendor's solution. JISC and other agencies will need to bear this in mind when considering whether to recommend particular tools.

<sup>21</sup> See: <http://www.oss-watch.ac.uk/resources/procurement08.xml>

**Import and export of data:** a particular issue in relation to tools is their capacity to exchange and export data for storage and other uses. This is a general issue with any software tool and purchasers often rightly have concerns about vendor 'lock-in'. However, any consideration of tools for HE use should also consider data exchange with the International E-Framework, JISC's InnovationBase project, and for sharing common information across the sector in general. Secondly, a more specific institutional concern centres around the ease with which EA tools can provide translation directly into automatic processes for creating business processes and software services. For example, LJMU were interested to explore further whether BiZZdesign Architect could export directly into Oracle's BPA toolset. A related issue is how much of an organisation's existing work, in say business process mapping, can be imported into a tool. All this needs more in-depth exploration with some full, 'round-trip' experiences from EA to actual software applications and services.

**Open Source EA tools:** there are currently limited options for institutions wanting to choose open source EA tools, although a review by Forrester (Peyret, 2008) may provide additional information for further study. The Open Group recently announced the TOGAF Customizer tool, a free and open source technology based on the Eclipse IDE Process Framework for use with TOGAF 9<sup>22</sup>. There is also Iteraplan, which describes itself as "the first open source tool for enterprise architecture management (EAM)"<sup>23</sup> and some project staff mentioned the importance for ontology development tools, for which there is at least one open source solution, Protégé<sup>24, 25</sup>.

Secondly, the work should review the many lists of EA tool requirements that have been developed by organisations such as Gartner, Forrester and the Institute for Enterprise Architecture Developments, in order to provide a baseline for HE requirements.

**Recommendation 2: JISC should consider amalgamating aspects of its work on low carbon ICT with its work on EA.**

Low carbon ICT is an area of activity that is strategically conducive to the EA approach. As both of these activities, within JISC, now fall within the remit of JOS, it should be possible to amalgamate aspects of them. As a starting point, consideration should be given to undertaking joint activity in the areas of Estates and Procurement; in particular, to the creation of Procurement and/or Estates working groups, which would be part of future EA work. Funding should be provided for participants to write up their observations and speculate on how they might use what they have learned.

In particular, the Procurement working group could work in collaboration with OSS Watch in order to address issues of open source software procurement, an area that is long overdue attention and which could generate outputs that would be useful to the sector more generally (see footnote 19, above). This could all be badged as a 'procurement of the

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<sup>22</sup> See: <http://www.infoworld.com/t/architecture/open-group-offers-enterprise-architecture-tool-548>

<sup>23</sup> See: <http://www.iteraplan.de/en/home>

<sup>24</sup> See: <http://protege.stanford.edu/index.html>

<sup>25</sup> The University of California at Irvine, has undertaken EA work using this tool, although using Zachman rather than TOGAF. See: <http://net.educause.edu/ir/library/powerpoint/CMR0409.pps> and <http://www.educause.edu/Resources/EnterpriseArchitectureImplement/148389>. See also The Essential Project (<http://www.essentialproject.org>), a modelling tool and metamodel project built on top of Protégé, which University of Wisconsin-Madison are using at the moment for higher level architecture artefacts and which Cardiff have begun to investigate.

future' initiative and could be expanded gradually to include the procurement of low carbon products and services.

Finally, it remains to be said that while there are many good strategic reasons why the adoption of EA could significantly benefit the sector there still remains much to learn. A handful of pioneers have begun the process and this report has summarised the main debates and learning points, and, in so doing, has attempted to resolve what might at first appear to be contradictory viewpoints. Issues of scope for example, the all-important 'what do we class as the enterprise', have been teased out into pragmatic solutions to resourcing and cultural conditions that are specific to HE. What has emerged is an approach to EA that is both broad and deep, vertical and horizontal. At the intra-institutional, or vertical level is pragmatic EA, the 'table top and legs' approach to EA; at the inter-institutional level is peer-to-peer EA, an approach which takes in the 'big picture' technological and strategic drivers, and cashes in on HE's strength – its ability to share and learn from others.

The overall conclusion is that the vision for EA in HE needs to be brave and bold. Making a success of EA within the sector will require an uncompromising focus on the big picture vision, both within institutions and across the sector.

## Appendix A

### Summary of EA lessons and tips in brief:

- EA is essentially a journey not a destination and indeed the journey can be more important for an organisation than any final product.
- As it is a journey, there is no need to try too hard to get it completely right first time.
- Governance of the EA process is extremely important.
- Architecture work should not be the sole preserve of the IS department.
- There is a tendency to focus EA work on systems and technologies, but actually the big areas of work involve people and their day-to-day work processes.
- Avoid being too 'purist' about EA. Adapt what framework is available to make it work for your particular institution.
- Keep EA work and those doing it tightly integrated and communicating with the rest of the organisation: it is easy to develop an 'ivory tower' mentality.
- Approach EA work with a view that it is an enabling and empowering tool rather than a management 'control' tool.
- Understand and articulate the institution's core operating model.
- To start: Build a very thin, lightly populated EA model of the entire institution.
- It is very important to get senior management engaged with EA work.
- All institutions have an architecture, but without formal EA work it is not modelled, mapped or understood.
- Don't be surprised if, when going round the TOGAF ADM, you find you have already been doing some of the things discussed.
- The real value in this kind of work is in sharing experience with others and realising that there may be no 'right' answer.
- Make use of others' architectural and data principles.
- Review TOGAF and select what will work best for your institution rather than trying to do everything.
- Avoid agonising over a governance infrastructure, select something and then tune as things go along.

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