IT Governance Design: An Application of Problem Oriented Engineering to Enterprise Architecture, TOGAF and SOA Development

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25 October, 2010

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TITLE:

IT Governance Design: An Application of Problem Oriented Engineering to Enterprise Architecture, TOGAF and SOA Development

A dissertation submitted in partial fulfilment

of the requirements for the Open University’s

Master of Science Degree

in Software Development

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X2917389

2nd March 2011

Word Count: Approx 17,000 (excluding titles and words in tables)
PREFACE

I would like to thank my supervisor, Dr Lucia Rapanotti, and my specialist adviser, Dr Jon Hall, for their guidance and support during this project – they have both been incredibly generous with their time and have provided regular assistance way beyond anything that I anticipated. I hope this project will contribute towards the growing body of research around Problem Oriented Engineering.

I would also like to thank David Roberts, Executive Director, and Dani Briscoe at the Corporate Infrastructure Forum for allowing me to use one of their regular monthly surveys of IT professionals in their member companies to gather data for this project. I would also like to thank the sizeable number of anonymous Enterprise Architects in some of the UK’s largest IT user organisations for completing my survey.

Above all, I would like to thank my family, especially my wife, Gill, for their support, patience and the sacrifices that have allowed me to spend the considerable amount of time required to complete this dissertation.
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ABSTRACT

This dissertation investigates the discipline of Enterprise Architecture in two ways. Firstly, as a fundamental part of IT Governance and, secondly, regarding its use for effective management and co-ordination of an organisation and the deployment of its IT solutions and applications. Enterprise Architecture should help enable an organisation to achieve its strategic goals.

TOGAF is a leading framework, which provides a selection of tools and best-practice methodologies for Enterprise Architecture practitioners. It is a relatively new development, especially version 9 (the latest release) and there are few examples in the literature of studies into its successful and effective application in pragmatic organisational practice. TOGAF has its roots in a technical approach, although, in line with IT Governance precepts, in its latest releases it urges close and wide stakeholder involvement in Enterprise Architecture initiatives.

Service Orientated Architecture (SOA) embodies and extends many of the principles of best practice in software engineering to provide an approach which can better address future business requirements in a flexible and more cost-effective way. To successfully implement SOA, a holistic view of an organisation’s IT architecture is essential and this is informed by the close involvement of the wider stakeholder community that is a fundamental principle of Enterprise Architecture and TOGAF.

This dissertation investigates stakeholder engagement in Enterprise Architecture initiatives through a case study. It examines in particular the success of applying TOGAF as an IT Governance framework in terms of involving stakeholders in the early design stages of an SOA development.

The case study is based on the author’s own experience applying TOGAF in a UK FTSE-100 company. A survey of UK IT end-user organisations was also carried out to determine whether the results of the case study investigation could be generalised across the UK Enterprise Architecture practitioner community.

Problem Oriented Engineering (POE), an emerging theoretical framework for design, was successfully used as a research methodology. It was found to be suitable
for the analysis due to its emphasis on stakeholder involvement in problem and solution exploration and validation and exploration of the consequent risks.
1. INTRODUCTION

This dissertation argues that the discipline of Enterprise Architecture (also referred to as EA) is a fundamental part of IT Governance. It also asserts that it is vital for effective management and co-ordination of an organisation and the deployment of its IT solutions and applications – allowing it to achieve its strategic goals. Service Orientated Architecture (SOA) is an architectural style that embodies and extends many of the principles of best practice in software engineering. It provides an approach which can better address future business requirements in a flexible and more cost-effective way. To effectively implement SOA, the holistic view of an organisation’s IT architecture provided by the discipline of Enterprise Architecture is essential.

Some key concepts are briefly introduced in the following section. These will be discussed in more detail in the next chapter.

1.1. IT GOVERNANCE

Calder (2009) describes IT Governance as a ‘framework for the leadership, organisational structures and business processes, standards and compliance to these standards, which ensure that the organisation’s IT supports and enables the achievement of its strategies and objectives.’

IT Governance is equally important in determining and controlling how an organisation chooses to deploy its IT resources to fulfil its business strategy.
1.2. ENTERPRISE ARCHITECTURE

The discipline of Enterprise Architecture has emerged over the past ten to fifteen years\(^1\) within the IT functions of many organisations. To be successfully implemented, Enterprise Architecture also depends on using the levers of effective IT Governance.

Enterprise Architecture is often portrayed at the intersection of an organisation’s IT strategy and business strategy. Its effectiveness depends upon specifying the optimal IT architecture to support the organisation’s business model.

Business models can vary significantly depending on the organisation, and they are contingent upon factors such as: type of organisational culture; customer (consumer or business); variety of products or services; tangibility of product or service; geographical diversity and various other factors.

The belief that there are certain characteristics shared between the business models of diverse organisations has led to the development of generic Enterprise Architecture frameworks and methodologies. In recent years a cross-industry body, the Open Group, has adapted and elaborated elements of these governmental frameworks into TOGAF – The Open Group Architectural Framework.\(^2\)

TOGAF 9, launched in 2009, is the current version of the framework. It has been extended to address many of the issues of IT Governance that are necessary to implement the techniques that the framework recommends for deploying an effective IT Enterprise Architecture.

In its listing of the benefits of IT architectural governance, TOGAF 9 states that it:

- \(\textit{Links IT processes, resources, and information to organizational strategies and objectives}\)
- \(\textit{Integrates and institutionalizes IT best practices}\)

\(^1\) \url{http://www.doi.gov/ocio/architecture/eainfo2.htm}

\(^2\) \url{http://www.opengroup.org/togaf/}
• Aligns with industry frameworks such as COBIT (planning and organizing, acquiring and implementing, delivering and supporting, and monitoring IT performance)

• Enables the organization to take full advantage of its information, infrastructure, and hardware and software assets

• Protects the underlying digital assets of the organization

• Supports regulatory and best practice requirements such as auditability, security, responsibility, and accountability

• Promotes visible risk management

(The Open Group, 2009)

TOGAF states that there are three important elements of an architecture governance strategy:

• A cross-organizational Architecture Board...to oversee the implementation of the IT governance strategy.

• A comprehensive set of architecture principle ...to guide, inform, and support the way in which an organization sets about fulfilling its mission through the use of IT.

• An Architecture Compliance strategy should be adopted...to ensure compliance with the architecture, including Project Impact Assessments, a formal Architecture Compliance review process, and possibly including the involvement of the architecture team in product procurement.’

(ibid)

In parallel with the development of architectural frameworks and methodologies, such as TOGAF, technical innovations in the nature of software development have enabled practical implementation of some of the key theoretical benefits of Enterprise Architecture, such as the elimination of duplication of software development in an organisation and re-use of existing software. This has allowed a closer association of business processes with discrete pieces of software which are specifically required to perform these processes.
1.3. SERVICE ORIENTATED ARCHITECTURE

These advances have led to the development of the architectural style of Service Orientated Architecture (SOA) where a ‘service’ in general terms represents a business process, such as ‘pay supplier’ or ‘retrieve customer details’. These common services can then be used by many diverse applications.

This is a significant challenge to conventional principles of system development, which have tended to result in the creation of departmental silos of systems and data and also the replication of commodity infrastructure and utility services.

To execute a business process under SOA, services are ‘orchestrated’ or ‘choreographed’ to form end-to-end business processes with the commodity services being called multiple times in many different business processes while other services are more specialised and used more rarely.

1.4. SOA AND IT GOVERNANCE

SOA is driven by the objective of creating a re-usable, interoperable and flexible architecture that can be used by the whole enterprise. This poses several problems related to IT Governance and Enterprise Architecture.

One practical problem with the principles underlying SOA is that the benefits seem self-evident from a theoretical and conceptual perspective. Software engineers prize re-use, flexibility, interoperability and elimination of duplication. However, such benefits, precisely because they fundamentally reduce potential costs by an intangible factor, are difficult to quantify and, consequently, use in a business case justification.

The benefits of following an SOA approach will largely accrue to the whole enterprise through cost-savings and more rapid development of potential future

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3 http://www-01.ibm.com/software/solutions/soa/ "Service Oriented Architecture (SOA) is a business-centric IT architectural approach that supports integrating your business as linked, repeatable business tasks, or services."
projects. However, the costs of implementing SOA need to be borne by the enterprise well before the benefits are realised.

By instituting structures such as architecture boards that draw membership from both IT and line of business management, effective IT governance mechanisms address such questions about balancing the benefits of investment in IT for the benefit of a whole organisation against the short-term expedients of individual departments in an organisation, which may often conflict.

1.5. PROBLEM ORIENTED ENGINEERING

Problem Oriented Engineering (POE) has been defined as:

‘an emerging framework for engineering design, which is seen as the creative, iterative and often open-ended undertaking of conceiving and developing products, systems and processes...POE is concerned with the fundamental question on how a solution can be designed to meet some requirements in a real world context...POE sees engineering design as a problem solving process in which interlocked steps of exploration and validation are repeatedly carried out: exploration is used for knowledge discovery and representation; validation is for quality assurance and risk management. Both involve stake-holders: finders contribute to exploration; validators contribute to validation.” [http://problemoriented.wikispaces.com/](http://problemoriented.wikispaces.com/) (2010)

The above description highlights that POE is a framework that emphasises the involvement of stake-holders in design processes, and the validation and management of risks. These are all concepts that are key to IT Governance initiatives.

This project applies POE in a real world context by examining processes used for IT Governance in SOA when TOGAF is followed.
1.6. AIM OF PROPOSED RESEARCH

SOA embodies and extends many of the principles of best practice in software engineering to provide an approach which can better address future business requirements in a flexible and more cost-effective way.

However, to implement SOA, the holistic view of an organisation’s IT architecture provided by the discipline of Enterprise Architecture is essential and a framework like TOGAF allows exchange and re-use of Enterprise Architecture best practices. In turn, Enterprise Architecture is dependent on effective IT Governance practices to ensure its implementation across an organisation.

POE as a framework for design can be used to rigorously examine the way that TOGAF provides an effective framework for the support of Enterprise Architecture for SOA development.

The overall aim of the research is to investigate TOGAF as an IT Governance framework for Enterprise Architecture in Service Orientated Development.

The research primarily addresses the initial design process and places emphasis on the earliest stages of systems analysis and design as these are most heavily influenced by Enterprise Architecture practice. More specifically, issues considered include:

- Scope of requirement elicitation – both functional and non-functional, including the identification of stakeholders and their validation conditions
- Early consideration of architectural issues in software developments
- Problem validation throughout the design process which may mitigate the risk that problems may be discovered at very late stages, such as user testing, which significantly increases costs

The research considers the above issues in the context of a case study which made use of an implementation of TOGAF. POE is used to examine both recommended practice and analyse evidence about practices collected by the project’s research.

The research question is discussed at the start of chapter three.
1.7. CONTRIBUTION TO BODY OF RESEARCH

Many of the areas which are the subject of this research are relatively new, such as Problem Oriented Engineering, TOGAF, IT Governance and Service Orientated Architecture. Therefore this research makes a contribution to knowledge in these areas, particularly in exploring their interaction.

IT Governance is an emerging subject for academic work and has a number of recognised authoritative texts, particularly in the area of legislative compliance and IT security. However, much of the literature relating to Enterprise Architecture (and its influence on IT Governance) is aimed at a practical, self-help market and often relies on anecdote and supposition to give evidence of a method’s effectiveness. Case studies, as used by Ross et al. (2006) are sometimes used but these tend to be treated anecdotally and not in a way which tests evidence against an academically accepted framework.

Similarly, some specialist texts on SOA Governance, such as Brown et al. (2009) and Marks (2008) are strong on recommending both organisational and technical solutions to promote IT Governance in an SOA environment. However, they fail to offer any substantial evidence to support their preferred approaches. Brown et al. (2009) use a fictional case study of a company called Ideation to illustrate governance in practice, while other authors are purely prescriptive. This may be partly because the books are written from the perspective of consultants. While the practical experience of consultants is valuable, their works tend to be written to support a commercially-marketeted methodology. Work in the academic literature is more likely to have its claims supported by a more rigorous examination of evidence. This research aims to contribute to the latter.

While TOGAF has existed in earlier iterations since the mid-1990s, it has only been widely adopted by Enterprise Architecture practitioners since the mid-2000s. The framework itself has also been substantially updated in version 9, which was released in 2009. Therefore, few studies have been carried out into its effectiveness as applied to Enterprise Architecture (see literature review).
One of the hypotheses is that using POE as a basis to examine TOGAF will offer an opportunity to analyse the underlying reasons for the success or failure of the application of the framework in IT Governance, particularly related to Service Orientated Architecture.

Previous studies have tested POE against well-defined software engineering problems, for example, in assurance driven design in safety critical systems. Critical elements of the POE framework have been shown to be applicable to the wider context of software development, notably its explicit separation of the roles of problem and solution exploration.

This project broadens the existing body of knowledge of the application of POE by examining its relevance to the implementation of Enterprise Architecture and IT Governance. These areas are interesting as they lie at the interface between human and technical influences in the software development process. For example, a sound IT Governance framework will promote principles such as traceability and transparency as a means of deconstructing possible human impediments to finding effective solutions. For example: not securing sufficient stakeholder involvement due to political power struggles; responses to a competitive environment; incompetence; jealousy over access to knowledge and resources, etc..

The audience for the research will include those who are interested in:

- Further application of Problem Oriented Engineering in software engineering
- Investigation of the effectiveness of IT Governance frameworks in improving corporate governance
- The TOGAF practitioner community
- Research into the benefits of a Service Orientated Architecture approach in software development
2. LITERATURE REVIEW

2.1. IT GOVERNANCE

The literature on IT Governance originates from both the technical fields of IT Security and the management imperatives of corporate governance.

Legislation has mandated the methods in which companies must be managed, such as Sarbanes-Oxley in the US (Calder, 2009, p.54). Simultaneously, much statutory regulation has been introduced with a direct impact on information technology, such as Data Protection Acts (ibid, p.41). The combination of the two created the discipline of IT Governance that organisations had a legal obligation to implement.

Texts such as ‘IT Governance’ (Calder, 2009)) provide a good entry to this emerging discipline. Calder recognises the importance of risk management to effective IT Governance:

‘...in a practical sense, the development of an IT governance framework is a control that enables an organisation to mitigate the strategic risks in its business model and strategy.’ (ibid)

Calder defines strategic risks relating to IT as:

1. Interruptions (whether from project failure or unplanned disruption) to business processes and customer services.

2. Overspending on IT, placing the company at a cost disadvantage compared to its competitors. (ibid).

Calder also defines a category of operational risk, which derives from an organisation’s inability to execute a programme designed to address it strategic risks, for example, failure to deliver IT services or lack of internal control.

Calder’s work is a good signpost to both the various regulatory imperatives, such as security compliance, and to the various tools that have been created to address governance issues. Some are international standards, such as BS ISO/IEC 38500 (Calder, 2010, p.75). Others include frameworks and methodologies including:
• COBIT (Control Objectives for Information Technology)\(^4\)
• ITIL (The IT Infrastructure Library)\(^5\)
• PRINCE2 (project management methodology)\(^6\)
• TOGAF (The Open Group Architecture Framework)\(^7\)

Calder’s work demonstrates the extensive scope of IT Governance – from conceptual architecture to the detailed operation of existing IT assets. The area of research of most relevance to this project is that of the governance of IT architecture.

‘IT Governance’ by Weill and Ross (2004) addresses the topic primarily from a strategic perspective. It is a work that is more concerned with management and organisational design than with the operation of IT. As proof of the importance of effective IT Governance the authors claim to have undertaken empirical research that proves that ‘top-performing enterprises generate returns on their IT investments up to 40 per cent greater than their competitors’ (ibid). Weill and Ross make a clear distinction between the taking of individual decision and the framework created to effectively facilitate that decision making:

‘We define IT Governance as specifying the decision rights and accountability framework to encourage desirable behaviour in using IT.’ (ibid)

The focus on decision rights and accountability framework puts emphasis on what other authors term stakeholder involvement. This is an important concept in Problem Oriented Engineering. Effective IT Governance must incorporate formal decision making involving all affected stakeholders in an organisation.

IT Governance is a term that tends to have a different definition depending on the perspective from which it is being viewed. Weill and Ross use a standpoint of

\(^4\) http://www.isaca.org/

\(^5\) http://www.itil-officialsite.com/home/home.asp

\(^6\) http://www.ogc.gov.uk/methods_prince_2.asp

\(^7\) http://www.opengroup.org/togaf/
corporate strategy with a book titled ‘Enterprise Architecture as Strategy’ following up their work on ‘IT Governance’.

Brand et al. (2007) write from a perspective that promotes the use of COBIT and ITIL – which are primarily libraries of processes for the management of IT development and service delivery. They choose to define IT Governance using a definition provided by the Organisation for Economic Co-Operation and Development (OECD):

‘IT Governance is the process by which IT within enterprises is directed and controlled. The IT Governance structure specifies the distribution of rights and responsibilities among different participants, such as the board, business and IT managers, and spells out the rules and procedures for making decisions on IT. By doing this, it also provides the structures through which the IT objectives are set, and the means of attaining those objectives and monitoring performance.’ (Brand et al. 2007).

Therefore the scope of IT Governance can extend very broadly across an organisation’s activities. Selig (2008) lists the following topics as included in scope:

- IT principles
- IT architecture
- SOA architecture
- IT infrastructure
- Business application needs
- IT investment and prioritisation
- People (human capital) development
- IT Governance policies, processes, mechanisms, tools and metrics

(Selig, 2008)

Calder (2009) recognises IT Architecture as one of his seven components of IT Governance and suggests an Enterprise Architecture Committee to provide governance in this area. This project acknowledges the wide scope of IT Governance
but will concentrate on areas relevant to Enterprise Architecture, such as IT Principles, SOA and IT Architecture.

2.2. ENTERPRISE ARCHITECTURE

The discipline of Enterprise Architecture has emerged over the past ten to fifteen years within the IT functions of many organisations. To be successfully implemented, Enterprise Architecture depends on using the levers of effective IT Governance.

Enterprise Architecture is often portrayed at the intersection of an organisation’s IT strategy and business strategy. Its effectiveness depends upon specifying the optimal IT architecture to support the organisation’s business model. It is defined by Ross et al. (2006) as ‘the organising logic for core business processes and IT infrastructure reflecting the standardisation and integration of a company’s operating model’.

Business models can vary significantly depending on the organisation, depending on factors such as type of customer (consumer or business), variety of products or services, tangibility of product or service, geographical diversity and various other factors.

In the last decade widespread adoption of integration and interoperability protocols has enabled wide scope for linkage of components of technically diverse ostensibly separate IT systems\(^8\).

The emphasis that Weill and Ross put on the strategic aspects of IT Governance has substantial overlap with the discipline of Enterprise Architecture that has emerged in the past two decades. Enterprise Architecture could be viewed as the conceptual result of successful IT governance at a strategic level.

Weill, Ross and Robertson (2006) combine the two disciplines in ‘Enterprise Architecture as Strategy’. As previously mentioned, they define Enterprise

\(^8\) Protocols include the adoption of such technical and interoperability standards as HTTP and TCP/IP, XML (eXtensible Mark Up Language), SOAP (Single Object Access Protocol), WSDL (Web Services Description Language) and REST (Representational State Transfer).
Architecture as ‘the organising logic for core business processes and IT infrastructure reflecting the standardisation and integration of a company’s operating model’. The authors make a persuasive case, using case studies from large companies, of the value of adopting an Enterprise Architecture strategy that complemented an organisation’s operating model. The operating models were defined by the combination of business process standardisation and business process integration leading to four categorisations: co-ordination, unification, diversification and replication. The authors argue that the architecture of an organisation’s IT systems would be substantially different for each of the models.

Van den Berg offers a useful definition of Enterprise Architecture, concluding with an often-quoted analogy:

‘[Enterprise Architectures] are meant to recognise shared features, position individual developments and govern mutual coherence. They are used to channel the overall set of changes, but also to ensure that any infrastructural requirements are met on time. This form of architecture exists at a very high conceptual level, has a broad scope and serves as a support for senior management in its high-level decision making...it is often compared to a city plan.’ (Van den Berg, 2006).

In parallel with the development of architectural frameworks and methodologies, such as TOGAF, technical innovations in the nature of software development have enabled practical implementation of some of the key theoretical benefits of Enterprise Architecture. These include the elimination of duplication of software development in an organisation and re-use of existing software. This has allowed a closer association of business processes with discrete pieces of software which are specifically required to perform these processes.

To achieve this objective, software engineering methodologies need to overcome some ingrained problems and inefficiencies, particularly the tendency to ignore long-term requirements through poor stakeholder engagement and failure to properly explore and validate problems and potential solutions.
2.3. ARCHITECTURAL FRAMEWORKS AND METHODOLOGIES

The belief that there are certain characteristics between organisations that can be
generalised has led to a number of Enterprise Architecture frameworks and
methodologies to be developed in the last ten to fifteen years. Historically, these
have tended to either be proprietary tools offered by consultants, such as the
Zachman Framework\(^9\), or have grown out of best practices specified by government
agencies – notably the US Department of Defense, with DODAF (Department of
Defense Architecture Framework)\(^10\).

More recently an Open Source initiative run by IT architects, the Open Group, has
adapted and elaborated elements of these governmental frameworks into TOGAF –
The Open Group Architectural Framework.\(^11\) The Open Group is a consortium of
over 300 academics, practitioners and suppliers who have developed the framework
using the principles of open source collaboration. The core material is freely
available on the internet for use by practitioners (although there are commercial
restrictions on trade-marking and training).

Since the first Enterprise Edition of TOGAF (version 8) was released in 2002 it has
become increasingly adopted by Enterprise Architects worldwide. TOGAF 9,
launched in 2009, is the current version of the framework and has been extended to
address many of the issues of IT Governance that are necessary to implement the
techniques that the framework recommends in deploying an effective IT Enterprise
Architecture.

As may be expected with a work that has such a widespread authorship, the TOGAF
reference material is more of a collection of example processes and their resultant
artefacts for practitioners to select for their own purposes than a strict procedural
methodology, such as ITIL. TOGAF’s definition of a framework is:

\(^9\) http://www.zachmaninternational.com/index.php/home-article/89#maincol

\(^10\) http://cio-nii.defense.gov/sites/dodaf20/index.html

\(^11\) http://www.opengroup.org/togaf/
‘A foundational structure, or set of structures, which can be used for developing a broad range of different architectures. It should describe a method for designing a target state of the enterprise in terms of a set of building blocks, and for showing how the building blocks fit together’ TOGAF (2009).

Picking up the earlier themes from the IT Governance literature of risk management and stakeholder involvement TOGAF justifies its use as an Enterprise Architecture framework:

‘Architecture design is a technically complex process, and the design of heterogeneous, multi-vendor architectures is particularly complex. TOGAF plays an important role in helping to “demystify” and de-risk the architecture development process’ (ibid).

Pre-TOGAF 9, previous releases of the framework concentrated more on technical aspects of IT architecture rather than specifically address Enterprise Architecture as a whole. Interestingly, TOGAF 9 still does not define Enterprise Architecture itself in a list of definitions that runs to 18 pages. Possibly because of this, and its relatively recent adoption by the practitioner community in the past few years, a literature search for TOGAF has yielded surprisingly few results.

Buckl et al. (2009) have studied the use of Enterprise Architecture Management Patters to complement TOGAF. They argue that TOGAF’s Architecture Development Method (ADM) is ‘highly generic’ and that it can be tailored more specifically to practitioners’ needs by the use of architecture patterns.

Chaczko et al. (2010) have published an account of the creation of a middleware integration model in the health sector using TOGAF. The study is interesting as it maps the various phases of the project studied to the appropriate phases of the TOGAF Architecture Development Method (ADM). However, it appears to be principally a narrative account of the project rather than an assessment of the methodology of TOGAF itself.
2.4. SERVICE ORIENTATED ARCHITECTURE

The recent advances and developments in information technology that were discussed in the previous chapter have led to the development of the architectural style of Service Orientated Architecture (SOA). Marks (2008) defines SOA as ‘a combination of Business Model, an IT Strategy, an architectural approach, an implementation pattern, all predicated on the concept of “Services”’.

In SOA a ‘service’ is roughly analogous to a business process: an IT system invokes a service to execute the required business process. Services may be defined at varying degrees of granularity. A high-level example might be ‘pay supplier’ or ‘retrieve customer details’. Lower level services may be ‘obtain address from customer postcode’ or ‘check credit card expiry date is valid’.

A key concept of SOA is the principle of interoperability that allows common services to be used by many diverse applications. The services are exposed as opposed to being hidden within the boundaries of traditional systems where often business processes are codified into the linear execution structure of second and third generation programming languages.

This is a significant challenge to conventional principles of system development, which have tended to result in the creation of departmental silos of systems and data and also the replication of commodity infrastructure and utility services.

To execute a business process under SOA, services are ‘orchestrated’ or ‘choreographed’ to form end-to-end business processes with the commodity services being called multiple times in many different business processes while other services are more specialised and used more rarely.

2.5. SOA AND IT GOVERNANCE

Frameworks such as TOGAF aim to integrate the technical IT development process with an organisation’s IT strategy through the application of the discipline of Enterprise Architecture throughout the application development lifecycle. IT Governance is an integral tool in achieving this process.
Both the definition and management of services with an organisation’s domain require careful governance in order to determine the optimum level of granularity of each service and also to ensure the maintenance and reliability of services.

Coherent Enterprise Architecture governance is a pre-requisite for successful implementation of SOA. Haki et al. (2010) describe how, as an architectural style, SOA governance is an extension of overall IT Governance:

‘SOA governance is a specialization that extends IT governance and focuses on managing effectively the lifecycle of a service. SOA governance handles the key decisions around IT and the business aspects of the service life cycle’. (Haki et al., 2010).

An SOA approach may therefore be an effective way of implementing the best practices of Enterprise Architecture. Arguably the key distinguishing factor of SOA development is its need to take into account the context of a much larger domain than the immediate problem at hand, either of the whole enterprise or of a significant section. Compared with traditional system development, an SOA approach requires requirements analysis to take into account issues beyond the immediate project or problem to be solved. Key aspects include:

- The need to consider end-to-end business processes
- Modelling each service so that it supports re-use
- The need to take a much wider scope than usual when performing requirements analysis
- Non-functional requirements, such as interoperability, scalability, availability need to be considered in anticipation of supporting re-use of the service by as-yet unknown business processes in the future

SOA is driven by the objective of creating a re-usable, interoperable and flexible architecture that can be used by the whole enterprise. This poses several problems related to IT Governance and Enterprise Architecture.
One practical problem with the principles underlying SOA is that the benefits seem self-evident from a theoretical and conceptual perspective – software engineers prize re-use, flexibility, interoperability and elimination of duplication. However, such benefits, precisely because they fundamentally reduce potential costs by an intangible factor, are difficult to quantify and, consequently for example, be used in a business case justification.

The benefits of following an SOA approach will largely accrue to the whole enterprise through cost-savings and more rapid development of potential future projects. However, the costs of implementing SOA need to be borne by the enterprise well before the benefits are realised.

Effective IT governance mechanisms address such questions about balancing the benefits of investment in IT for the benefit of a whole organisation against the short-term expedients of individual departments in an organisation, which may often conflict.

This awareness of the interaction between different parts of an organisation is mirrored on a more technical level by the development of Service Orientated Architecture in which business functions defined as re-usable entities that are orchestrated together to perform business processes.

As Weill and Ross suggest, this development requires active IT governance which both ‘simultaneously empowers and controls’. Aier (2006) has produced a paper that uses ‘methodological aspects like how to find appropriate service domains and an appropriate granularity of the services’. This uses mathematical clustering algorithms to analyse an Enterprise Architecture and justify the optimum design of SOA architecture.

An organisation can pay for its investment in SOA architecture in two ways:

- Mandate projects under development to use the wider scope of SOA development and requirements analysis and to allow each project an according increase in the resources available (time and money)
• Institute a centralised architecture initiative independent of any project work that will investigate business processes across the organisation and specify how systems could be re-engineered in a way that would allow future development to be carried out in an SOA architecture.

The literature argues about how such different approaches might be best managed.

Web services are an inherent part of SOA and Ortega et al. (2009) describe an approach to using an Enterprise Architecture framework to justify the use of SOA techniques on a case study of a help desk application.

Engels and Assman (2008) give a good historical account of how Service Oriented Architecture concepts have affected the evolution of Enterprise Architecture and identify a possible form of future evolution.

Various prescriptive books have been published on SOA and Governance which tend to be based on the experiences of a practitioner often working for a consultancy or IT supplier. Examples include: Brown’s “SOA Governance: Achieving and Sustaining Business and IT Agility” (2009) which is published by IBM press; and Marks’ ‘Service Oriented Architecture Governance for the Services Driven Enterprise’ (2008) based on experiences at a management consulting firm.

Brown (2009) suggests a paradigm of a ‘Services Factory’ for development of Service Oriented Architecture which requires a high degree of requirements analysis. Brown uses the interesting (though not entirely historically accurate) analogy of mass industrialisation in manufacturing industry to support the argument for a services factory:

‘SOA employs significantly more standardization than traditional application development and SOA governance must strive to encourage and support this standardization. Services have interfaces defined in a standard way, execute in standard operating environments, and use a common technical infrastructure...In much the same way that the standardization of components led to the industrial revolution, such standardization of services can enable services to be constructed...”
using manufacturing or assembly line approach – a software production line or service factory to create all of the necessary work products.’ (Brown, 2009)

This shift is crucial in understanding the changes within organisations that an SOA may bring, rather than having an IT department create bespoke solutions which exactly match diverse business requirements (as with pre-industrial tradesmen), the lower costs gained from the efficiencies created by the ‘services factory’ more than compensate for the need for businesses to adapt their processes to make use of this low-cost standardisation: the difference between a Rolls Royce and a Ford.

Marks (2008) presents a governance reference model for the whole organisation which provides a framework for managing development across the entire enterprise to support SOA principles. There is a similar emphasis on how SOA changes the balance of resource allocation within an organisation:

‘Governance is performed for a reason, and it is not because organisations love governance processes or oversight boards. SOA governance is performed to help business outcomes will be realised through allocation of resources to SOA initiatives, programs, and activities, as agreed to and governed by appropriate stakeholders.’ (Marks, 2008)

Marks further emphasises that the involvement of business stakeholders in the governance of SOA has a beneficial effect on wider IT Governance:

‘Enterprise governance based on an SOA strategy, goals and objectives...enables a more comprehensive and pre-aligned view of governance as opposed to trying to scale a very narrowly defined view of technical services governance into a model that governs processes, portfolios and the alignment of SOA activities to business and mission goals.’ (ibid)

Therefore it could be argued that as well as SOA extending Enterprise Architecture governance it also reinforces the necessity of such governance.
2.6. PROBLEM ORIENTED ENGINEERING

POE is an emerging framework whose logical and mathematical underpinning has been laid down by Hall et al. (2007) in ‘Problem oriented software engineering: A design-theoretic framework for software engineering’.

Nkwocha (2010) summarises the founding principles of POE:

‘POE sees engineering as problem solving process in which interlocking exploration and validation steps are carried out: exploration of knowledge and its representation; and validation of represented knowledge. Both involve stakeholders...POE problems concern the fundamental engineering question of how a solution can be designed to meet the requirements of stakeholders in a real world context. Framing a POE problem is then a process of discovering relevant knowledge pertaining to those problem elements, and from that synthesising the solution’ (Nkwocha, 2010)

Figure 1 adapted from Nkwocha’s work, illustrates the key processes involved in examining a problem using POE. What is most notable is the emphasis placed on validating both the problem and the solution. If either the problem or the solution fails to reflect the requirements within the relevant context domain then POE ensures that the consequent risks are at least recorded and addressed. Such a failure may either be because the problem or solution has failed validation but may also be because pragmatic considerations have allowed a move to solution exploration before problem validation has been carried out.
To explain the nomenclature in Figure 1:

- **Stage 1** – Problem Exploration – denotes the full range of activities required to fully understand the problem

- **Stage 2** – Problem Validation – is the choice point at which it is determined whether the problem has been fully explored

- **Stage 3** – Solution Exploration – comprises all the activities required to determine a candidate solution

- **Stage 4** – Solution Validation – tests that the solution satisfies requirements and offers a solution that is valid for the whole problem

Iteration is possible. The dotted line shows that iteration can take place between the problem and solution exploration phases.

The roles of Problem and Solution Validator are specifically designed to ensure that a problem’s stakeholders are fully engaged in the POE process. Hall (2008) states
that ‘Engineering design by necessity includes [...] the construction of arguments that the solution will provide the functionality and qualities that are needed. Identifying and involving stakeholders is a key feature of POE.’

POE’s emphasis on fully exploiting stakeholders’ tacit knowledge in validating problems and solutions addresses a concern raised by Crawford (2010) about the problems created by a simplistic over-reliance on abstracted, rules-based decision making:

‘Often sense-making entails not so much problem solving as problem finding... in the real world problems don’t present themselves in [a] pre-digested way; usually there is too much information; and it is difficult to know what is pertinent and what isn’t... Even the boundaries [of the problem] can be ambiguous; making discriminations of pertinence cannot be achieved by the application of rules, and requires the kind of judgement that comes with experience.’ (Crawford, 2010, p35-6)

An increasing amount of research, of which this project is part, has tested POE as an analytical and predictive framework in various instances of design and software development.

This may prove to be particularly relevant when applied to problems in software engineering that border on management practice and organisational politics, such as Enterprise Architecture, which is something this project aims to test.

The literature on POE has applied the framework to other software engineering problems. A good application of the benefits of applying POE’s formal rigour is to safety critical systems. Mannering et al. (2006) provide a case study of how POE was used to effectively combine the design and the validation of a failure annunciation system in military aircraft. Hall et al. (2008) also applied the POE framework to the design of a package router (in a problem drawn from existing literature) in a paper that emphasises POE’s roots in mathematical theory (such as sequent calculus12 and Gentzen’s natural deduction13).

Nkwocha’s (2010) work further extends POE’s application to real world problems by examining a problem associated with processing mortgage applications in a financial institution and showing how the process could be improved through the introduction of early problem validation.

The emphasis on problem validation in addition to problem explanation is particular appropriate for SOA development. For example, if a service is designed with an expectation of discovery and re-use by future business processes then extra consideration should be made of the type of problems that the service should be designed to address in the future.

It is a widespread belief that large numbers of IT developments have failed in the past because of inability to engage widely with stakeholders and poor requirements analysis, particularly a tendency towards ‘solutioning’ where inappropriate solutions are prematurely adopted without the underlying problem being fully explored. POE addresses these weaknesses, the elimination of which is more critical to the success of an SOA architecture than in a traditional model.

POE places emphasis on risk management, stakeholder validation and problem and solution verification. These areas also emerge from a review of the literature on IT Governance and Enterprise Architecture as critical for success in software development, suggesting that POE will be an appropriate research tool in this project.

POE is developing a notation to describe both a problem itself and the process used to solve the problem. One type of notation is used to complement the process pattern notation, which is used to capture the steps carried out in problem solving processes (as in Figure 1). The notation below captures the problem itself in a problem diagram (as in Figure 2) by identifying its basic building blocks:

- Problem domain context – denoted by a rectangle with a single line
- Solution to be designed – a rectangle with a double outline

The requirement – denoted by an ellipse

![Diagram showing POE notation with Context Domain, Solution to be Found, and Requirement]

**FIGURE 2 - POE Notation**

**FIGURE 3 - Inter-Relationship between POE Building Blocks**

Using POE a problem can be both justified, a process which captures knowledge for stakeholder validation, and transformed. Transformations capture the steps involved in solving a problem. Justifications are used to capture the rationale that might be provided to a problem, context or solution’s stakeholders when making a transformation to solve a problem.

The above is a very brief introduction to POE and more detailed discussion and analysis of examples will be featured in the next section.
2.7. SUMMARY

The literature review considered the rationale for both IT Governance and Enterprise Architecture. If it is accepted that governance is essential in the overall application of information technology to a business then Enterprise Architecture is a discipline which provides the ability to effectively manage and co-ordinate the organisation and deployment of IT solutions and applications to meet an organisation’s business requirements and to achieve its strategic goals.

Service Orientated Architecture is an architectural style which complements the premise that Enterprise Architecture should primarily align IT with business requirements. It organises IT processes into services that closely reflect business processes at various levels of granularity. Successful implementation of SOA necessarily requires a close understanding of stakeholder requirements and has an underlying motivation that IT should reflect, and serve, an organisation’s business processes. However, successful SOA adoption requires a holistic approach that transcends individual project requirements by considering how a collection of services best functions for the organisation as a whole. Effective IT governance is required to achieve this holistic approach.

TOGAF is a leading framework which provides a selection of tools and best-practice methodologies for Enterprise Architecture practitioners. However, it is a relatively new development, especially version 9 (the latest release) and the literature search did not yield many academic reviews of its effectiveness. TOGAF also has its roots in a technical approach and, while in its latest releases, it urges close and wide stakeholder involvement in Enterprise Architecture it may do so from a theoretical and idealistic perspective which may be unrealistic when implemented in pragmatic real-life situations.

As discussed above, TOGAF’s relatively recent development and adoption (at least in an IT Governance context) has meant there is little evidence in the literature, especially when applied in pragmatic real-life situations.

For successful implementation, SOA requires effective IT governance that incorporates the best practices recommended in TOGAF, particularly its emphasis on
considering the interests of a wide group of stakeholders (particularly business users) and its consideration of the interdependence between IT systems and their interaction.

POE is a problem solving methodology which places emphasis on stakeholder involvement in problem and solution exploration and validation and explores the consequent risks, providing a good tool for analysing stakeholder management in the TOGAF methodology.
3. RESEARCH METHOD

My research question is:

‘To what extent does the involvement of stakeholders affect the success of applying TOGAF as an IT Governance framework in the early design stages of an SOA development?’

Based on the literature review the following research hypotheses were formulated in support of the research question:

- H1: Stakeholder involvement is a key success factor in an Enterprise Architecture initiative
- H2: Close engagement with business process experts is useful in identifying candidates as services for SOA
- H3: POE can be applied to capture stakeholder involvement in key processes of an Enterprise Architecture initiative
- H4: POE can be used to reason about risk in those processes

A discussion of the choice of research method to tackle these hypotheses follows below.

3.1. RATIONALE OF CHOICE OF RESEARCH METHOD

An appropriate research method was required to gather data which was suitable for examining both the subject and to satisfy the investigating technique. Various potential research methods are considered below.

The first decision regarding research methods is to decide whether to pursue theoretical and analytical research or take an empirical approach.

The key distinction between the two approaches is the collection and analysis of new, primary evidence. The ‘M801 Research Project and Dissertation: Study Guide’ states:
'theoretical/analytical: reviews existing evidence and extends the discourse by bringing different pieces of evidence together to provide additional analysis and to suggest new perspectives...empirical: provides new evidence and considers its implications (e.g. a demonstration of a concept, the refinement and implementation of a technique for a new context, the practical implementation of a bit of theory.) (Open University, 2007).

The preceding literature review has sought to examine the extent of the available research relevant to the research question. While there is sufficient research to guide this research, the literature review has demonstrated that there is little available research relating to the efficacy of IT Governance Frameworks. This makes a theoretical research method unviable because the existing literature does not constitute a rich enough source of data in itself.

A core research question relates to whether POE provides a viable method for analysing TOGAF as an architectural framework. POE is a relatively recent, emerging methodology and the current body of research has concentrated on applying its theoretical foundations to practical problems. As the research is concerned with the practical application of POE it fits Sharp et al.’s (2002) definition of ‘Application of a Methodology’ within their classification of types of common purposes of analysis and applicable techniques:

‘A type of research project...that requires students to demonstrate that they can apply some of the methodology successfully...Analysis in the context of applying a methodology requires the student to do things:

1. To explain the application of the methodology clearly

2. To make it clear they understand the conceptual and theoretical bases of the methodology.

In many cases there will be added a third purpose, to evaluate the methodology. It is by no means easy to achieve these aims.’ (Sharp et al., 2002).

In the future enough research may have been conducted in practically applying POE to provide the basis of a theoretical review of the resulting overall literature.
However, any current research into POE is necessarily best served its testing against the collection of empirical evidence.

Many types of empirical evidence can be collected. Various factors determine which were selected as the most appropriate in answering the research question. These included:

- How the evidence will be used: as discussed above, the principal research aim of this project is the application of POE as a methodology. This required the identification of suitable evidence: the identification of a problem about which enough data can be gathered so that inputs such as problem requirements and domain context could be analysed from a POE perspective.

- Cost and practicality: this is an MSc research project and the resources available were largely limited to those that could be provided on a part-time basis from the author with support from the supervisor and specialist advisor. External funding to assist with collection and analysis of data was not available, for example to pay for administrative assistance or for extra research. The scope of the research was necessarily realistic and achievable in the timescales available.

- Availability: Enterprise Architecture relates closely to corporate strategy and the effective use of IT systems in successfully realising that strategy. Information about the strategic effectiveness of IT systems is likely to be viewed by organisations as sensitive and confidential. It is unlikely that commercial organisations would allow enough of this type of information into the public domain that would allow comparative research between organisations to be carried out.

- Bias and validity: The success of an organisation can be measured in many different ways and is also influenced by many inter-relating factors, both internal and external. It would be a naive appeal to metrics to conclude that, for example, the introduction of a new methodology for Enterprise Architecture had a direct causal effect on an increase in an organisation’s profitability.
The above considerations show that data collected had to fulfil the following requirements:

- Accessible
- Of suitable scope to be analysed with the resources available
- Rich enough in contextual detail to provide sufficient data for POE

One possible method of research may have been to take an experimental approach. This could have involved either a controlled experiment, prototyping or some field research in which different approaches to a particular problem were compared. For example, the same software development problem could be presented to different teams of developers and project managers who would then work on a suitable problem for an SOA approach using a distinct number of methods: one team employing IT Governance that conforms to POE; another with a less formalised IT Governance methodology, a control group that worked with no governance and so on.

However, there are significant disadvantages to an experimental approach. Many factors affect the success of IT development activities and it would be difficult to ensure the validity of the data produced and to remove bias. The problem to be solved by each of the teams would need to be identically specified and the resources and skills available to the teams would have to be equally available. This is unlikely to be a viable use of any organisation’s scarce IT development resources unless the research was able to cover the cost of all resources used. This would be beyond the scope of this study.

If experimental research was not practical then other methods of empirical research needed to be considered. These included:

- Survey research and questionnaires: these techniques are based on generalising conclusions from a statistically significant sample population from which data has been collected. The type of data collected is designed to be standardised and repeatable across statistically significant populations e.g. yes/no questions, Likert scales. There is some scope for collection of non-standardised data for qualitative analysis.
• Observation: which involves the researcher observing the behaviour of a subject generating data that is sufficiently structured to bear analysis.

• Interview: capturing information in dialogue (usually verbal) between the researcher and a subject. While interviews should be structured in advance in order to collect the required data, there is considerable scope for the data that is captured to vary between interviewees.

• Document studies: this is the analysis of previously existent documents which were produced for non-research purposes (e.g. historical records, such as meeting minutes, technical documentation, etc.).

• Case studies: these may use elements of all of the above forms of research but differ in that the study is produced specifically for bespoke investigative or illustrative purposes. ‘Case studies are in-depth, descriptive examinations, usually of a small number of cases or examples. They provide an intensive, holistic description of a single phenomenon, investigated in situ...Analysis tends to be inductive reasoning based upon multiple data sources.’ (Open University, 2007)

There are a number of reasons why a case study approach was considered the most effective research method for this project taking into account the above requirements. For the purposes of testing the POE methodology it was more important to provide a detailed source of research data. While it would have been very useful to identify a problem that occurred in many different organisations, the resources available for this project meant a trade-off was required between the breadth of data collection and the detail obtained which caused the research to be limited principally to one organisation. The amount and type of data that could be gathered by surveys and questionnaires sent to many organisations was also not likely to produce data that can be analysed using POE.

POE is based on principles of inductive, logical reasoning which, as the M801 Study Guide states (see above) is suitable for use with the type of data generated in a case study. Some previous POE studies have also successfully used case-study and literature-based research
There is also extensive use of case studies in the literature on IT Governance and SOA implementation: Ross et al (2006) and Weill and Ross (2004) make prominent use of case studies from organisations such as Delta Airlines, Cemex and ING to emphasise the applicability of their research to the ‘real world’. The pervasiveness of the case study approach to areas where management theory and IT interact is demonstrated by the many fictional case studies created by authors to illustrate principles that are either too new to be innovative or protected by client confidentiality, as in Brown et al.’s (2009) Ideation.

The existence of previous studies using case studies as a research method was used to validate a similar approach in this project. (It could be argued that use of a different research technique might complement the existing literature regarding IT Governance, SOA and POE. However, for reasons discussed above this would probably be beyond the scope of this project.).

A practical reason why a case study approach was appropriate for this project was the availability of data. I have personal experience of working in the design of IT Governance in a FTSE-100 company and have also worked on projects that have sought to implement SOA architecture within the company. Therefore I had access to a comprehensive source from ‘real-world’ SOA investigations and developments including technical artefacts and other documentation, such as IT strategy documents, technical roadmaps, standards, project portfolio material, etc.

I have investigated material that I have worked on in the area of SOA development since 2004 and have identified material was developed into a representative case study adequate for the purposes of answering the research question.

However, case studies are demanding and intensive and also have limits to the amount that their findings can be generalised.

Given the nature of the available data about the application of TOGAF IT Governance practices and SOA development, a useful approach was to use POE as a framework to analyse small, specific processes in detail, comparing theoretical, prescriptive processes as may be found in TOGAF as a governance framework and
those that have been observed to have occurred in practice, using the evidence
gathered in research.

Factors such as risks, resource use and stakeholder communication could be
compared for all processes under analysis. Reasons for any failures in effective
problem solving could have been deduced using POE as an analytical framework and
then used to recommend improvement in processes.

If one expects frameworks such as TOGAF to prove effective in improving IT
governance then it would be expected that analysis of the framework using POE
would identify less risks, more effective resource use and more effective stakeholder
communication than an analysis of a ‘real world’ SOA development which may have
been conducted without a governance methodology. This might provide a hypothesis
which the POE framework could be used to answer.

In order to help generalisation of the results, the case study was supplemented by a
survey. This was a questionnaire completed by IT architecture practitioners which
aimed to provide more general validation for the conclusions from the case study
research. This followed the example of Nkwocha’s research (2009) which primarily
investigated a single case study but also supplemented this with survey data from a
questionnaire.

3.2. EXAMPLE OF USE OF PROBLEM ORIENTED
ENGINEERING

An effective way of introducing the concepts of Problem Oriented Engineering is to
use an example of a theoretical problem: this section examines how a process
implemented from TOGAF might be examined using POE.

The summary of the analysis below is an example of how similar methods will be
employed to examine the data obtained in primary research.

The example is how software delivery and quality might be improved if an
organisation implements an Architecture Review Board – a process described in
Chapter 47 of TOGAF 9.
[the Architecture Board] is the executive-level group responsible for the review and maintenance of the strategic architecture and all of its sub-architectures...[it] is the sponsor of the architecture within the enterprise, but the Architecture Board itself needs an executive sponsor from the highest level of the corporation. This commitment must span the planning process and continue into the maintenance phase of the architecture project. In many companies that fail in an architecture planning effort, there is a notable lack of executive participation and encouragement for the project. (TOGAF (2009) Section 47)

Note that, in common with the majority of TOGAF, the implementation of the process is not prescriptive. For example, the framework offers recommendations and examples of how an Architecture Board might be implemented. In the example below TOGAF’s recommendations have been adapted into an implementation scenario, partly based on my own experience.

Because of TOGAF’s non-prescriptive nature, the example has been framed by using a theoretical scenario that has an ending point of the implementation of the introduction of an Architecture Review board. POE is used to examine the decision making process and how a general requirement can be transformed and justified into a specific solution.

The scenario starts when an organisation recognises that its overall operational performance is less efficient than its senior management (CEO and board) believe to be its potential. This diagnosis may possibly have been confirmed by peer benchmarking or other analysis.

There may be many reasons for this organisational underperformance but, for the purposes of this example, one of the causes will be considered by the organisation’s stakeholders to include its use of Information Technology and, specifically, the lack of optimisation and alignment that the literature review above identifies as a sign of deficient Enterprise Architecture. The decision process in this scenario can be described linguistically as approximately:
• External focus on improving quality: the motivation behind examining IT processes in general

• Focus on architecture: focusing on areas which can be addressed using TOGAF as a methodology

• TOGAF Architecture board selected from best practice methodologies available: selecting a solution to the problem from those available in TOGAF

Many other causes besides the organisation’s ineffective Enterprise Architecture may also be responsible for contributing to the high-level problem. An analysis of each of these problems could be also performed using the POE process described in this example. However, for the purposes of illustration this example will ‘drill-down’ to the point where a TOGAF recommended course of action is implemented.

The POE process pattern, as introduced in the literature review, is assumed to be being followed in each iteration of the problem solving process:

• The problem will be explored then validated with the appropriate stakeholders

• A solution to the problem will be explored and then validated with the appropriate stakeholders

• The next problem step will not take place until the solution has been validated to the satisfaction of the validating stakeholders

Table 1 describes the first two steps using POE terminology. The first transformation in the diagram addresses a requirement to improve the delivery of IT in the context of the wider organisational improvements required.

The justification describes both the transformation between the first two steps and the selection of the improvement of IT delivery as one specific component of the larger problem that is examined in detail for the purposes of this example. Table 1 and Figure 4 illustrate how the improvements to IT and the requirement for an IT Management Development Plan can be illustrated in the wider context of the whole organisation and the requirement for related initiatives.
The POE process will be described using the problem diagram graphical notation introduced previously in the literature review (double sided box for solution, single sided box for context domain and ellipse for requirement). For greater clarity in the diagram the names of the solution, context domains and requirements are abbreviated and can be referenced to longer descriptions of the problem in Table 1. Also included in the table are descriptions of the justifications used to move from one representation of the problem to the next: such justifications must be acceptable to the solution’s validating stakeholders. The justifications are represented on the diagram by numbers.

As the problem is transformed within the diagram in Figure 4, a similar contextual representation could be drawn for each transformation which narrows the context domain of the next step. However, such extra figurative representation is omitted in this example for simplicity.
TABLE 1 - Plain Language Descriptions for First To Second Stage POE Transformations

<table>
<thead>
<tr>
<th>Justification</th>
<th>Solution</th>
<th>Context</th>
<th>Requirement</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Management Action Plan</strong>: a plan drawn up by the organisation’s management to identify reasons for underperformance and suggest initiatives to counter these reasons.</td>
<td><strong>Organisation (ORG)</strong>: the constituent parts of the organisation that are under the control of the CEO and Board.</td>
<td><strong>Improve Performance (Imp P)</strong>: identification, perhaps via peer reviewing or benchmarking, of under performance of organisation and start of initiative to improve performance.</td>
<td></td>
</tr>
</tbody>
</table>

1. **Identification of improvement required overall in organisation**: CEO and Board require improvement throughout organisation resulting in a Management Action Plan.
   a. For the purposes of this example, attention will be focused on the specific actions regarding the delivery of projects within the IT department\(^{14}\). A plan is required to improve delivery in the IT Department.
   b. A specific solution identified for the context of the IT department is to introduce or re-start an Enterprise Architecture initiative – as the benefits of Enterprise Architecture should be manifested in the improvement of IT delivery.

<table>
<thead>
<tr>
<th>Justification</th>
<th>Solution</th>
<th>Context</th>
<th>Requirement</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td><strong>Introduce or re-start Enterprise Architecture initiative (Intro EA)</strong>: Enterprise Architecture selected as a solution as it promotes a holistic and co-ordinated approach to IT initiatives that are efficiently aligned with corporate strategy.</td>
<td><strong>IT Department (IT)</strong>: the division of the organisation under the control of the CIO (or IT Director)</td>
<td><strong>Improve IT Delivery (Imp IT Del)</strong>: a requirement to focus specifically on the delivery of IT initiatives, which have been identified as poorly aligned to strategy and generally uncoordinated.</td>
<td></td>
</tr>
</tbody>
</table>

Figure 5 uses the POE notation to describe the transformation in Table 1 above. A middle step has been shown which decomposes the box representing the organisation as context (ORG) into its constituent parts. A line is drawn linking the Management Plan solution with IT (an example constituent of the solution).

The next step in the transformation shows the displayed context is narrowed to IT and the requirement has been correspondingly transformed to Improve IT Delivery (Imp IT Del).

\(^{14}\) See plain language description of problem above.
FIGURE 4 - Detailed POE Notation of First Two Steps
Table 2 and Figure 5 represent the whole process at a higher level of abstraction. Longer descriptions are omitted from the table and steps between the different problems in the diagrams have been simplified.

In the table, the context, requirement and solution are presented on alternate lines from the justification that is used to transform each from the next. Figure 5 represents the problem transformation process from with the original problem (termed the premise problem) at the top to the solution at the bottom.

In Figure 5 POE notation is used to show each step in the process as separated from the next by a line – with the initial premise problem presented at the bottom of the diagram and the solved problem at the top.

Square brackets at the end of the lines are used to hold justifications. The solution validating stakeholders are represented in the ‘fish tails’ at the end of the lines.
TABLE 2 - NATURAL LANGUAGE DESCRIPTIONS OF PROBLEM ELEMENTS

<table>
<thead>
<tr>
<th>Justification</th>
<th>Solution</th>
<th>Context</th>
<th>Requirement</th>
<th>Stakeholders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management Action Plan</td>
<td>Organisation (ORG)</td>
<td>Improve Performance (Imp P)</td>
<td>CEO/CFO/CIO Board</td>
<td></td>
</tr>
</tbody>
</table>

1. Identification of improvement required overall in organisation: CEO and Board require improvement throughout organisation resulting in a Management Action Plan. For the purposes of this example, attention will be focused on the specific actions regarding the delivery of projects within the IT department (see earlier example). A plan is required to improve delivery in the IT Department. The solution is to introduce or re-start an Enterprise Architecture initiative – as the benefits of Enterprise Architecture should be manifested in the improvement of IT delivery.

   Introduce or re-start Enterprise Architecture initiative (Intro EA) | IT Department (IT) | Improve IT Delivery (Imp IT Del) | CIO/IT Management |

2. The IT Planning and Strategy department selects TOGAF as a framework to use in its implementation of an Enterprise Architecture initiative and sets up (or re-invigorates) an Enterprise Architecture Department.

   Use TOGAF as a Framework (Use TOGAF) | IT Planning and Strategy Department (IT Plan And Strat) | Select suitable EA methodology to improve performance (Sel Meth) | CIO/IT Management / Enterprise Architect |

3. Architecture Review Board selected as a technique from TOGAF by the Enterprise Architecture Department as appropriate mechanism to improve overall performance.

   TOGAF Enterprise Architecture Board (TOGAF EAB) | Enterprise Architecture Dept | Select suitable Governance mechanism from TOGAF (Sel TOG Gov M) | CIO/IT Management / Enterprise Architect |

4. An operating architecture board is introduced, staffed by relevant committee members.

   Operating Architecture Board (Op AB) | Arch Board Committee | Introduce TOGAF Architecture Board (Intro TOGAF AB) | CIO/IT Management / Enterprise Architect / Architecture Board Committee |

Solution: Architecture board set up and operating.
FIGURE 5 - TOGAF Architecture Review Board Example Described With Poe Notation
Figure 5 (the fish diagram) shows how each solution in the problem solving process is justified to the validating stakeholders before the next step is started. Therefore, the CIO and Board validate the creation of an IT Improvement plan. The CIO and senior IT management validate the introduction (or re-launch) of Enterprise Architecture as a component of the plan and so on.

This process continues until a point is reached where the decision is made to implement the Architecture Review board, which is a practical activity that represents the end state.

The use of POE allows a more methodical and rigorous approach to both the decision making process itself and its representation so that the assumptions and context of the decisions may be documented in a way that allows external scrutiny.

In this example it can be seen that a decision to implement an Architecture Review board clearly relates to the identification of a wider problem and that the intermediate steps used to reach the decision also imply the adoption of other parts of TOGAF.
4. DATA COLLECTION

Two types of data collection and analysis were used for this project:

- A detailed case study based on my own industrial experience and practice as an Enterprise Architect

- A short survey sent to other Enterprise Architecture practitioners to test the extent to which my industrial practice is typical of Enterprise Architecture practitioners in general

4.1. CASE STUDY

4.1.1. CHOICE OF PROJECT

I have practised as an Enterprise Architect in a large, FTSE-100 listed company for several years and have had access to a large amount of primary documentation from Enterprise Architecture projects that I have worked on. For reasons of commercial sensitivity the company and the exact nature of the data have been anonymised. In any event, it is more important for the purposes of the analysis to examine the processes rather than details of the technological initiative in the case study itself.

I considered many projects for analysis in this dissertation. These included:

1. An application architecture initiative, designed to test the feasibility of adopting an SOA approach across the company

2. A major business re-engineering initiative that aimed to replace a major market’s mainframe computer system with a modern system from an external supplier

3. Introduction of a group intranet after a merger

4. Feasibility study into implementing infrastructure project to support introduction of SOA architecture
I chose to use the fourth project (the SOA infrastructure feasibility study) as the case study for a number of reasons:

- I was project manager so had personal knowledge of all decision making that affected the project

- As the project was fairly small (about €500k with an average of three people for nine months) its scope of the project was tightly focused

- The project dealt with technical details but its implementation was necessary to enable SOA implementation, which was assumed to have major business benefits

The project was known as ‘Enterprise Connection Architecture’. This was a deliberately generic title which included in its scope many technologies that had proprietary brand names that were part of suppliers’ marketing strategies, mostly variants on a middleware technology known as an Enterprise Service Bus (Chappell, 2004). A mixture of message broking server technology allied to the adoption of web-services and SOA standards, suppliers claimed this would ‘enable fast and flexible application integration with reduced cost and bridging to next-generation interconnectivity [and] decouple complex integration logic from each application with a central, integration solution eliminating point-to-point connectivity programming.’\(^{15}\)

Despite its technical focus, this was a case study that business stakeholders would potentially derive great benefit from. However, it was traditionally the type of initiative that would be kept within the boundaries of the IT department.

TOGAF suggests that any major IT project should have the involvement of business stakeholders and this case study had major implications for the architecture of business applications once its recommendations had been agreed and implemented or not. These recommendations argued:

---

that the company bases its future IT architecture on Service Orientated Architecture (SOA). The recommended company-wide implementation of the infrastructure required to support these principles is termed the Enterprise Connection Architecture (ECA). ECA will realise the recommendations of the recent group-wide IT Application Architecture project and increase the company’s IT delivery capability based on industry best practice. Moreover, it will enable IT to react with increased responsiveness and flexibility to changes in the tourism market – corresponding to the company’s business objectives.

Introducing SOA implies major changes to the way that IT is organised, managed and implemented within the company. However, the potential business benefits are even higher, particularly in increased speed to market and significant overall cost savings. Using an Enterprise Services Bus as the basis for the new Enterprise Connection Architecture will allow us to incrementally build and distribute the new architecture.’ (Clarke, Horn, Tozer, 2006)

This was an argument for the company to allocate significant resources in the implementation of this technology. Therefore it would be likely that such investment would need to be approved by stakeholders outside the IT department.

As it was a feasibility study, the project was concerned with the initial phases of the IT project lifecycle (i.e. excluding detailed design and implementation) rather than a detailed technical examination. This allowed the scope of the analysis to be matched to one phase of the TOGAF Architecture Development Method (ADM), enabling more detailed analysis.

Phase A of TOGAF’s ADM – ‘The Architecture Vision’ – provided an appropriate framework for the analysis of this case study. Selected objectives of this phase are to:

‘...provide a first-cut, high level description of the Baseline and Target Architectures, covering the business, data, application and technology domains. These outline descriptions are developed in subsequent phases. [It will] provide the sponsor with a key tool to sell the benefits of the proposed capability to stakeholders and decision-makers within the enterprise. [It]
describes how the new capability will meet the business goals and strategic objectives and address the stakeholder concerns when implemented.’ (TOGAF, 2009)

The emphasis that this phase of TOGAF places on addressing stakeholder concerns also fulfils a key tenet of Problem Oriented Engineering: that risks should be explicitly explored and validated by all relevant stakeholders.

4.1.2. **Analysis of Case Study**

This case study was analysed in two ways:

- It was tested against the recommended best practice of the TOGAF Enterprise Architecture Framework
- Problem Oriented Engineering was used as a framework to examine both the implementation of the case study as it was implemented and also how its implementation might have been guided using the TOGAF framework

Material contributing to the case study comprises primary materials such as management reports, project plans, technical documentation, organisation charts, meeting minutes and the final project documentation. Additionally, the author, as project manager, had personal recollection of project activities. This analysis had free access to all the above data but commercial confidentiality prevents any extensive publication of primary material in this dissertation.

As the focus of the analysis was to examine stakeholder interaction, a technique was used which aimed to identify relevant stakeholders of the project in the case study and to examine which elements of the project involved different types of stakeholder.

TOGAF addresses the issues involved in communicating between disparate interest groups by featuring a chapter on Stakeholder Management (section 24).

Because of the diversity of organisations where the framework could be implemented, TOGAF does not provide a definitive list of stakeholder types. Instead it offers an example list of stakeholders that could be used to construct a stakeholder map. (Also
note that, as TOGAF is non-prescriptive, that the stakeholder analysis below is of an illustrative, generalised range of stakeholders that may not apply in all circumstances where TOGAF could be applied.

This list has been used for analysis of the case study (with some simplification and consolidation of less relevant specialist stakeholders). The list is shown in Table 3.
TABLE 3 - TOGAF Example Stakeholders

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterprise Architect</td>
<td>Produces Enterprise Architecture</td>
</tr>
<tr>
<td>CEO/CxO/Board</td>
<td>Senior management of organisation</td>
</tr>
<tr>
<td>CIO/IT Director</td>
<td>Responsible for IT Function</td>
</tr>
<tr>
<td>Programme Mgt. Office</td>
<td>Prioritises projects, allocates funding, controls some levers of IT Governance</td>
</tr>
<tr>
<td>Procurement</td>
<td>Responsible for 3rd party vendors</td>
</tr>
<tr>
<td>HR</td>
<td>Responsible for personnel related issues</td>
</tr>
<tr>
<td>Enterprise Security</td>
<td>Responsible for Security Architecture</td>
</tr>
<tr>
<td>QA/Standards Group</td>
<td>High level governance compliance – e.g. Internal audit</td>
</tr>
<tr>
<td>End User Management</td>
<td>Senior &amp; line management of divisions carrying out business process</td>
</tr>
<tr>
<td>Business Domain Experts</td>
<td>Experts in business processes</td>
</tr>
<tr>
<td>IT Service Management</td>
<td>Responsible for Managing IT Services</td>
</tr>
<tr>
<td>IT Ops</td>
<td>Responsible for IT Infrastructure and its operation</td>
</tr>
<tr>
<td>IT Project Management</td>
<td>Delivers IT business change projects</td>
</tr>
<tr>
<td>Technical Specialist</td>
<td>Responsible for delivery of IT project</td>
</tr>
<tr>
<td>Regulatory Bodies</td>
<td>Government bodies, standards institutes, etc.</td>
</tr>
<tr>
<td>Suppliers</td>
<td>Suppliers of IT products and services</td>
</tr>
</tbody>
</table>

It was necessary to simplify these stakeholders into larger, generic groupings in order to examine the processes involved in the case study using UML activity diagrams.
The stakeholders were, therefore, aggregated into the following groupings. Note that this grouping is carried out for illustrative purposes and later analysis may address particular interaction with an individual type of stakeholder within one of the groupings.

<table>
<thead>
<tr>
<th>EA/Project</th>
<th>IT Strategic</th>
<th>Bus. Strategic</th>
<th>IT Specialist</th>
<th>Bus Specialist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterprise Architect</td>
<td>CIO</td>
<td>CEO/CxO/Board</td>
<td>IT Ops</td>
<td>Business Domain Experts</td>
</tr>
<tr>
<td>IT Project Management</td>
<td>Proj Mgt Office</td>
<td>HR</td>
<td>IT Service Management</td>
<td>End User Line Management</td>
</tr>
<tr>
<td>Procurement</td>
<td>Procurement</td>
<td>QA/Standards</td>
<td>Technical Specialists</td>
<td></td>
</tr>
<tr>
<td>Enterprise Security</td>
<td>Enterprise Security</td>
<td>Senior End User Management</td>
<td>Suppliers</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Regulatory Bodies</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TABLE 4 - Stakeholder Groupings Used In Generic TOGAF Activity Diagram

The involvement of the above stakeholders was mapped against the steps listed by TOGAF as constituting Phase A (the Architecture Vision – section 7.4). These steps are analogous to individual business processes within this phase.

4.2. SURVEY

To establish whether the close analysis of the above case study could be potentially generalised to a larger Enterprise Architecture community a survey was also carried out. The survey, in itself, does not give any primary evidence that the case study results can be generally applied but it gives an indication of how typical my industrial practice is of Enterprise Architecture practitioners in general. If it is found to be representative then some tentative conclusions may be drawn that the results from the case study may apply to other organisations although this may be more likely to present a hypothesis for future research than a firm conclusion as the responding organisations in the survey have not been studied in similar detail to the case study.
The survey and all its questions were designed and specified by the author as part of a joint piece of research with the Corporate Infrastructure Forum with its members (the majority of the largest IT user organisations in the UK). The survey was used as its October 2010 ‘Reality Checker’. The questions were wholly devised by the author but were formatted by Corporate Infrastructure Forum staff into an online survey.¹⁶ The survey was hosted on the Forum’s website but e-mails with links to the survey were sent to employees in the Forum’s member companies who registered an interest in Enterprise Architecture in their online membership profiles. The survey was also referenced in communication with the Forum’s wider membership population, such as newsletters.

The survey questions were principally motivated by the findings of the review of the literature in this project and on initial findings of the analysis of this project’s case study.

The survey was necessarily short but aimed to sample the level of adoption of IT governance frameworks, particularly TOGAF, and to gauge the level of involvement of different stakeholder groups in Enterprise Architecture decision making. It also questioned respondents about how Enterprise Architecture had been perceived to have influenced IT best practice in their organisations and whether Enterprise Architecture had contributed to any overall business benefit. The survey also contained a short section on Enterprise Architecture tools, which was primarily added for the benefit of the Corporate Infrastructure Forum. It was issued in the first week of October 2010 and responses were collated on 5th November 2010.

An example of the full survey is attached in Appendix 2. The general structure of the survey is as follows:

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¹⁶ The Corporate Infrastructure Forum’s ‘Reality Checkers’ are a monthly series of online questionnaires on topical subjects of relevance to the IT user community. Results are made available to the forum’s members at the end of each month.
1. Personal information (name, organisation, e-mail address). This data was not analysed, except for an aggregate list of the organisations that participated (see Appendix 4)

2. IT strategy – a question about the extent of internal usage of an IT strategy (or lack of one)

3. Extent of usage of Enterprise Architecture Frameworks (TOGAF, Zachman, proprietary (e.g. IAF), in-house)

4. Extent of modification of adopted EA framework/methodology

5. How many other IT Governance frameworks are in use by the organisation (e.g. ITIL, CoBIT, PRINCE2)?

6. Stakeholder interaction – how frequently did the EA practice interact with each type of stakeholder

7. Which factors made the EA department or initiative a success?

8. The extent of benefits that EA has brought to the organisation

9. Which, if any, EA tools are used by the organisation?\textsuperscript{17}

Data was collected principally using yes/no responses or by the use of Likert scales (mostly on a 1-4 range). For example: what is your level of adoption of these governance frameworks – mandatory, frequent, rare, never?). Free text comments were also invited.

The survey was sent out by the Corporate Infrastructure Forum to Enterprise Architecture practitioners in major companies and governmental organisations in the UK. The respondents’ organisations are listed in Appendix 4.

\textsuperscript{17} This question was included primarily for the interest of the members of the Corporate IT Forum.
5. RESULTS

5.1. CASE STUDY

TOGAF lists 11 steps in Phase A of its Architecture Development Method (ADM) – ‘The Architecture Vision’ – which are summarised in Table 5 and used in the case study. The work involved in each step is specified in more detail within the TOGAF documentation.

<table>
<thead>
<tr>
<th>Steps in TOGAF Phase A – Developing the Architecture Vision</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Establish architecture project</td>
</tr>
<tr>
<td>2. Identify stakeholders, concerns and business requirements</td>
</tr>
<tr>
<td>3. Confirm and elaborate business goals, business drivers and constraints</td>
</tr>
<tr>
<td>4. Evaluate business capabilities</td>
</tr>
<tr>
<td>5. Assess readiness for business transformation</td>
</tr>
<tr>
<td>6. Define scope</td>
</tr>
<tr>
<td>7. Confirm and elaborate architecture principles, including business principles</td>
</tr>
<tr>
<td>8. Develop architecture vision</td>
</tr>
<tr>
<td>9. Define the Target Architecture value propositions and KPIs</td>
</tr>
<tr>
<td>10. Identify the business transformation risks and mitigation activities</td>
</tr>
<tr>
<td>11. Develop Enterprise Architecture plans and Statement of Architecture Work, secure approval</td>
</tr>
</tbody>
</table>
5.1.1. **CASE STUDY STAKEHOLDER ANALYSIS**

Using the more detailed information for each activity in Phase A (as broken down in the TOGAF documentation) each of the stages was mapped against the stakeholders involved in the process using an activity diagram based on UML. Each swim-lane corresponds to a stakeholder grouping in Table 4.

For example, step 1 (Establish Architecture Project) is performed, according to TOGAF, by ‘securing enterprise-wide recognition of the project, the endorsement of the corporate management, and the support and commitment of the necessary line management’. The activity is, therefore, positioned across both IT Strategic and Business Strategic swim-lanes. Throughout the interpretation of TOGAF it has been assumed that the Enterprise Architecture project is primarily executed, if not initiated, within the IT department.

Figure 6 is a representation of the generic TOGAF process.
Note that there is no significance attached to the positioning of the diamonds denoting decision points, only the activities are mapped to stakeholder groups. Also note that step 11 has been decomposed into two processes: one for the development of Enterprise Architecture plans and another to secure their approval.

The range of stakeholders involved in the case study was more limited than those in the TOGAF example but they were able to be mapped into the same grouping (see Table 6).

<table>
<thead>
<tr>
<th>EA/Project</th>
<th>IT Strategic</th>
<th>Bus. Strategic</th>
<th>IT Specialist</th>
<th>Bus Specialist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterprise Architect</td>
<td>CIO</td>
<td>CEO/CxO/Board</td>
<td>Technical Specialists</td>
<td>Business Domain Experts</td>
</tr>
<tr>
<td>IT Project Management</td>
<td>Proj Mgt Office</td>
<td>QA/Standards</td>
<td>Suppliers</td>
<td>End User Line Management</td>
</tr>
<tr>
<td>IT Project Management</td>
<td>Procurement</td>
<td>Senior End User Management</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TABLE 6 - Stakeholders in Case Study Mapped Into Groups

The involvement of stakeholders in the real-life ECA case-study project is similarly mapped in Figure 7 using the same format of activity diagram. This is a real application of the TOGAF model as it was used in the case study and so shows the actual sequence of steps taken in the project. These are denoted by the thicker lines whereas paths that were not taken are shown in grey.
The case-study was conducted with the intention of using TOGAF as a model. However, as TOGAF is a recommended framework rather than prescriptive or mandatory, it was adapted as appropriate, both to the size and exploratory nature of the project and also to the organisation.

Comparison of the two diagrams reveals the following differences between the TOGAF framework and how the case-study was implemented in practice.

- Step 1, Establish Architecture Project, was commissioned wholly by IT Strategic stakeholders – principally by the CIO and an associated governance board – and did not seek to gain support from any business stakeholders at the project’s inception.

- Similarly, step 3 – Confirm and Elaborate Business Goals, Drivers and Constraints – was only carried out in consultation with IT strategic stakeholders. The absence of this confirmation checkpoint led to the decision point in the TOGAF process model being superfluous.
- Step 6 – Define Scope – also only involved IT Strategic stakeholders.

- The decision point after step 7 – Confirm and Elaborate Architecture Principles, including Business Principles – was the first point in the real-life implementation in which any validation of the problem had taken place. If validation failed then the project would have to have returned to step 2 for another iteration.

- In the real-life implementation, step 9 (Define Target Architecture, Value Propositions and KPIs) was completed by members of the Enterprise Architecture team and IT Specialists. It did not involve IT Strategic stakeholders.

- Step 10 – Identify Business Transformation Risks and Mitigation – was carried out with Business Specialist stakeholders but did not involve Business Strategic stakeholders, as suggested in TOGAF.

- Steps 11 and 11.1 – Develop EA Plans and Statement of Architecture Work and Securing Their Approval – involved the same group of stakeholders in practice as in the TOGAF model (i.e. both Business and IT Strategic).

- Neither the TOGAF model nor the implemented project featured an explicit escape route if the project was considered unnecessary or appropriate for abandonment. In practice, had this have been necessary then governance controls outside the scope of the project would probably have been used to halt work. However, both models contained an internal pre-disposition towards their continuation to completion, regardless of the whether they still provided a valid solution for stakeholders.

In conclusion, the ECA project had closely followed the steps recommended in the TOGAF process but had failed to involve the recommended stakeholders in each step, most notably the Business Strategic stakeholders, such as non-IT board members and senior line-of-business managers. The first point at which these stakeholders became involved in the project was at the final step – when they were asked to approve work
on the next phase of the project (defined by TOGAF Phase B – Business Architecture).

5.1.2. CASE STUDY VIEWED USING THE POE PROCESS PATTERN

The techniques of Problem Oriented Engineering were then used to examine how the processes recommended in TOGAF compared with the real-life example of the case study. In particular, POE’s focus on stakeholder relationships and the management of risk may be able to explain from an analytical perspective the differences between the model and how it was instantiated.

The results are represented by one figure and two explanatory tables:

- A swim-lane diagram allocating each step of the project into its respective role in the POE process model
- A table explaining how stakeholders have been allocated into groups
- A table explaining the swim-lane diagram in more detail

Figure 8 represents the TOGAF model, as analysed in the activity diagram in Figure 7. The figure is divided into four columns according to the key stages in the POE process model: problem exploration; problem validation; solution exploration; and solution validation.
FIGURE 8 - TOGAF ADM Phase A Steps Mapped To POE Process

In the representations of the TOGAF model and case study examples, the roles of problem and solution validator have been assigned to the decision points that follow specific stages, although not all stakeholders who were involved in the preceding stage play a validation role (e.g. the solution validator role after 11.1 – Secure approval for next stage – is a role that is played by senior decision makers only).

The same classification of individual stakeholders into groupings is retained in this section as has been used for the swim-lane analysis. Figure 6 summarises this breakdown for this example. However, it should be noted that stakeholders may be assigned into different groupings according to the problem context. This is a necessarily subjective task and reflects the action each stakehoelder brings to the problem rather than an abstract such as a job title (i.e. what a stakeholder does in practice rather than may be externally inferred).

The classification of the TOGAF example stakeholders into their respective POE roles raised interesting questions about the involvement of stakeholders in the project as the same stakeholders can act in distinctly different ways at each step in the
process. For example, in classifying stakeholders it has been assumed that a validator is normally a stakeholder that has the ability to make executive decisions within the organisation. However, such decision makers may also heavily influence the exploration of a problem or solution.

For example, in Table 7, the Enterprise Architect and CIO are both finders and validators. This recognises the practicality of their personal involvement in all stages of the problem. They may (and, perhaps ought to, according to POE) employ different skill sets in each role. Similarly, several stakeholders play roles in both the problem finding and solution parts of the POE process model. This may be inevitable for those most closely involved with the sponsorship of the problem because they initiate, run and conclude the process as a project. However, to avoid ‘solutioning’ POE suggests that participants should be able to clearly separate problem and solution investigation in their own practice.
<table>
<thead>
<tr>
<th><strong>Problem Finder</strong></th>
<th><strong>Problem Validator</strong></th>
<th><strong>Solution Finder</strong></th>
<th><strong>Solution Validator</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterprise Architect</td>
<td>CIO</td>
<td>Enterprise Architect</td>
<td>CIO</td>
</tr>
<tr>
<td>CIO</td>
<td>CEO/Board</td>
<td>CIO</td>
<td>CEO/Board</td>
</tr>
<tr>
<td>Project Management Office</td>
<td>Senior End User Management</td>
<td>Project Management Office</td>
<td>Senior End User Management</td>
</tr>
<tr>
<td>CEO/Board</td>
<td></td>
<td>CEO/Board</td>
<td></td>
</tr>
<tr>
<td>Senior End User Management</td>
<td></td>
<td>Senior End User Management</td>
<td></td>
</tr>
<tr>
<td>IT Ops/Technical Specialists</td>
<td></td>
<td>Suppliers/Procurement</td>
<td></td>
</tr>
<tr>
<td>Business Domain Experts</td>
<td></td>
<td>IT Ops/Technical Specialists</td>
<td></td>
</tr>
<tr>
<td>End User Line Management</td>
<td></td>
<td>Business Domain Experts</td>
<td></td>
</tr>
<tr>
<td>IT Ops/Technical Specialists</td>
<td></td>
<td>End User Line Management</td>
<td></td>
</tr>
</tbody>
</table>

TABLE 7 - Stakeholders Assigned To POE Roles in TOGAF Process

The justifications for classifying each step of Phase A into its respective position in the POE process pattern (problem/solution finder) are detailed in Table 8, while the decision points in the process have been categorised as validation steps.
<table>
<thead>
<tr>
<th>Steps in TOGAF Phase A – Developing the Architecture Vision</th>
<th>POE Process</th>
<th>Stakeholder Group</th>
<th>Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Establish architecture project</td>
<td>Problem</td>
<td>IT Strategic/ Business Strategic</td>
<td>Process initiated to address perceived problem.</td>
</tr>
<tr>
<td>2. Identify stakeholders, concerns and business requirements</td>
<td>Problem</td>
<td>Enterprise Architects / Project Team</td>
<td>Preparatory work and information gathering to allow problem investigation.</td>
</tr>
<tr>
<td>3. Confirm and elaborate business goals, business drivers and constraints</td>
<td>Problem</td>
<td>IT Strategic/ Business Strategic</td>
<td>Confirmation of key business information by senior stakeholders that is required to fully analyse the problem – based on information gathered by project team.</td>
</tr>
<tr>
<td>4. Evaluate business capabilities</td>
<td>Problem</td>
<td>Business Specialist</td>
<td>Analytical and evaluative work based on investigation derived from primary investigation into business processes.</td>
</tr>
<tr>
<td>5. Assess readiness for business transformation</td>
<td>Problem</td>
<td>Enterprise Architects / Project Team</td>
<td>Preparatory activity for definition of scope of project.</td>
</tr>
<tr>
<td>6. Define scope</td>
<td>Problem</td>
<td>IT Strategic/ Business Strategic</td>
<td>Formal decision over scope of project.</td>
</tr>
<tr>
<td>7. Confirm and elaborate architecture principles, including business principles</td>
<td>Problem</td>
<td>Enterprise Architects / IT Strategic</td>
<td>Confirmation and validation that architecture principles are sufficient to provide framework to evaluate solutions.</td>
</tr>
<tr>
<td>8. Develop architecture vision</td>
<td>Solution</td>
<td>Enterprise Architects / IT Strategic</td>
<td>Production of architecture vision based on problem investigation and architectural principles.</td>
</tr>
<tr>
<td>Finding</td>
<td>Project Team</td>
<td>principles</td>
<td></td>
</tr>
<tr>
<td>---------</td>
<td>--------------</td>
<td>------------</td>
<td></td>
</tr>
<tr>
<td>9. Define the Target Architecture value propositions and KPIs</td>
<td>Solution Finding</td>
<td>Enterprise Architects / IT Strategic</td>
<td>Further work on the architectural solution and linking the solution further with business metrics (e.g. value propositions and KPIs)</td>
</tr>
<tr>
<td>10. Identify the business transformation risks and mitigation activities</td>
<td>Solution Finding</td>
<td>Business Strategic / Business Specialist</td>
<td>Work with business strategic and specialist stakeholders to explore risks of possible solutions</td>
</tr>
<tr>
<td>11. Develop Enterprise Architecture plans and Statement of Architecture Work, secure approval</td>
<td>Solution Finding</td>
<td>Enterprise Architects / Project Team</td>
<td>Refine final set of plans and proposals for validation by senior stakeholders.</td>
</tr>
<tr>
<td>11.2 Secure Approval</td>
<td>Solution Finding &amp; Validation</td>
<td>IT Strategic / Business Strategic</td>
<td>Formal validation by senior stakeholders.</td>
</tr>
</tbody>
</table>
This figure can then be compared with the POE process model, as discussed in the literature review. The following points may be noted:

- The main components of the POE process model – problem and solution exploration and validation are present in the model
- Problem validation occurs at two points – after step 3 (confirm goals, drivers and constraints) and stage 7 (confirm and elaborate principles)
- A validation stage does not immediately follow definition of the target architecture (step 9)
- Solution validation happens at the final stage (11.1 – Secure Approval) but at no stage earlier in the process

Figure 9 represents the TOGAF model, as analysed in the activity diagram in Figure 8. The figure is divided into four columns according to the key stages in the POE process model: problem exploration; problem validation; solution exploration; and solution validation. Each step in the TOGAF process has been categorised in Table 10 according to its role in the POE process model, either problem or solution validation, while the decision points in the process have been categorised as validation steps.

Figure 9 shows the case-study ECA project (as broken down into TOGAF steps) analysed using the POE process model. As with Figure 7, this is a real application of the TOGAF model as it was used in the case study and so shows the actual sequence of steps taken in the project. These are denoted by the thicker lines whereas paths that were not taken are shown in grey.
Table 9 shows how stakeholders have been assigned to the POE roles in the case study implementation. This table, based on actual experience, includes fewer types of stakeholder than the table detailing the generic TOGAF example stakeholder roles. However, the same issue is encountered where some stakeholders perform different POE roles at different stages of the process. It is arguable whether it is a benefit that the CIO, for example, has a stakeholder presence in all POE roles. This could suggest that any problem or solution exploration might lack external rigour and become self-fulfilling or, alternatively, it might be seen as a good method of ensuring alignment with a key stakeholder’s objectives.
<table>
<thead>
<tr>
<th>Problem Finder</th>
<th>Problem Validator</th>
<th>Solution Finder</th>
<th>Solution Validator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterprise Architect</td>
<td>CIO</td>
<td>Enterprise Architect</td>
<td>CIO</td>
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<tr>
<td>CIO</td>
<td>Senior IT Management</td>
<td>CIO</td>
<td>CEO/Board</td>
</tr>
<tr>
<td>Senior IT Management</td>
<td>Project Management Office</td>
<td>Senior End User Management</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IT Ops/Technical Specialists</td>
<td></td>
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<tr>
<td></td>
<td>Business Domain Experts</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>End User Line Management</td>
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<td></td>
</tr>
</tbody>
</table>

TABLE 9 - Stakeholders Assigned To POE Roles in Case Study
<table>
<thead>
<tr>
<th>Steps in ECA Project</th>
<th>POE Process</th>
<th>Stakeholder Group</th>
<th>Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Establish architecture project</td>
<td>Problem Finding</td>
<td>IT Strategic</td>
<td>Process initiated to address perceived problem but only by IT Strategic stakeholders.</td>
</tr>
<tr>
<td>2. Identify stakeholders, concerns and business requirements</td>
<td>Problem Finding</td>
<td>Enterprise Architects / Project Team</td>
<td>Preparatory work and information gathering to allow problem investigation</td>
</tr>
<tr>
<td>3. Confirm and elaborate business goals, business drivers and constraints</td>
<td>Problem Finding</td>
<td>IT Strategic</td>
<td>Confirmation of key business information by senior IT stakeholders that is required to fully analyse the problem – based on information gathered by project team.</td>
</tr>
<tr>
<td>4. Evaluate business capabilities</td>
<td>Problem Finding</td>
<td>Business Specialist</td>
<td>Analytical and evaluative work based on investigation derived from primary investigation into business processes.</td>
</tr>
<tr>
<td>5. Assess readiness for business transformation</td>
<td>Problem Finding</td>
<td>Enterprise Architects / Project Team</td>
<td>Preparatory activity for definition of scope of project</td>
</tr>
<tr>
<td>6. Define scope</td>
<td>Problem Finding</td>
<td>IT Strategic</td>
<td>Formal decision over scope of project – only by senior IT stakeholders</td>
</tr>
<tr>
<td>7. Confirm and elaborate architecture principles, including business principles</td>
<td>Problem Finding &amp; Validation</td>
<td>Enterprise Architects / IT Strategic</td>
<td>Confirmation and validation that architecture principles are sufficient to provide framework to evaluate solutions.</td>
</tr>
<tr>
<td>8. Develop architecture vision</td>
<td>Solution Finding</td>
<td>Enterprise Architects / IT Specialists</td>
<td>Production of architecture vision based on problem investigation and architectural principles</td>
</tr>
<tr>
<td>9. Define the Target Architecture value propositions and KPIs</td>
<td>Solution Finding</td>
<td>Enterprise Architects / IT Specialist</td>
<td>Further work on the architectural solution and linking the solution further with business metrics (e.g. value propositions and KPIs) – by EA team and IT Specialists</td>
</tr>
<tr>
<td>10. Identify the business transformation risks and mitigation activities</td>
<td>Solution Finding</td>
<td>Business Specialist</td>
<td>Work with business strategic and specialist stakeholders to explore risks of possible solutions</td>
</tr>
</tbody>
</table>
11. Develop Enterprise Architecture plans and Statement of Architecture Work, secure approval

<table>
<thead>
<tr>
<th>Solution Finding</th>
<th>Enterprise Architects</th>
<th>Project Team</th>
<th>Refine final set of plans and proposals for validation by senior stakeholders.</th>
</tr>
</thead>
</table>

11.1 Secure Approval

<table>
<thead>
<tr>
<th>Solution Finding &amp; Validation</th>
<th>IT Strategic/ Business Strategic</th>
<th>Formal validation by senior stakeholders – first formal involvement of Business Strategic stakeholders</th>
</tr>
</thead>
</table>
The following observations can be made (when also taking into account the seniority of the stakeholders involved in each step i.e. specialist rather than strategic stakeholder in some steps):

- **Step 3 (Confirm Goals, Drivers and Constraints)** is a step which explicitly requires validation but this did not formally occur and any validation was carried out on an ad hoc basis as part of the problem exploration process. Had the first decision point not been superfluous (after step 3) then the TOGAF process would have returned to step one, avoiding much wasted effort in the later stages.

- Problem validation did occur after stage 7 (Confirm and Elaborate Principles) but the rejection path if validation failed led back to stage two of the project, implying a high risk of wasted effort and re-work required.

- In the real-life implementation, step 9 did not involve IT Strategic stakeholders, which exposed the project to the risk of developing a solution target architecture which had not been validated by senior management in either business or IT.

- Some solution validation was undertaken with Business Specialist stakeholders in step 10 (Identify Business Risks and Mitigation). It was carried out with Business Specialist stakeholders but did not involve Business Strategic stakeholders, as suggested in TOGAF. However, because this was incomplete due to lack of involvement of the Business Strategic stakeholders, it has not been represented as a step in the POE process model.

- The final solution validation stage (11.1 – Secure Approval) was the first formal involvement of the Business Strategic stakeholders in the project. Therefore, the return path from the solution validation decision point must go back to a very early step in the project – step 2 – and requires problem exploration and validation to take place in a second iteration. Steps 11 and 11.1 were the first points in the project in practice that Business Strategic stakeholders had been involved. Therefore, if the project’s target architecture
was rejected then the step two would need to be returned to – effectively making much of the project work redundant. In the TOGAF process, because of the earlier validation by Business Strategic stakeholders after step seven then the risks of needing to carry out a large amount of rework were substantially lessened.

Problems and solutions explored by the ECA project team may not have been validated by the full range of stakeholders. In turn, this led to the risk of wasted effort and a requirement for re-work should the project’s assumptions on areas such as business requirements, capabilities and goals not been shared by those influential stakeholders.

In practice, it was also found that direction given from groups of stakeholders and, also, different levels of hierarchy in the same type of stakeholder could be contradictory and required extra iterations of steps to resolve.

For example, ‘business strategic’ stakeholders included representatives of both a finance department (for which cost minimisation was a key objective) and operational departments (who would benefit from investment in IT infrastructure). The ambiguity resulting from these conflicts could not be resolved by an Enterprise Architecture project team alone and had to be referred to a stakeholder in the organisation with sufficient authority: the CEO or Board whose involvement was confined to the last phase of the project.

Similarly, lower-level stakeholders within a business department often viewed solutions in the context of existing IT systems and were not party to the strategic plans of their senior management. Therefore the more specialist a business stakeholder the more likely their views of a solution would be constrained by intimate knowledge of the existing problem. A more senior stakeholder in the same part of the business was able to view the more abstract benefits afforded by more radical system changes (i.e. tweaking a system as opposed to replacement).

In conclusion, the ECA project was able to be modelled using the POE process pattern, showing that its activities first concentrated upon problem finding and then moved on to solution finding. Problem validation only occurred at one stage in the
process (once the whole of the problem exploration phase had been completed, unlike in the TOGAF model where an earlier validation point was recommended). Solution validation occurred, at the end of the solution exploration phase, which also marked the only formal involvement of strategic business stakeholders.

As both the validation points occurred at the end of each phase, rather than validation occurring as an ongoing activity during the exploration phases. This meant that had validation failed (being rejected by the strategic stakeholders at their limited points of contact) then the project would have had to return to very early phases to refine and rework its problem definition and solution. This represents a high risk of wasted effort being expended on non-implementable solutions.

5.2. SURVEY

The full results of the survey are included in Appendix 3. Results to selected questions appear below in graphical form with some of the most salient findings briefly highlighted in commentary.

There was a good response to an unsolicited survey of this type – with 38 responses from 25 separate organisations.

For the purposes of this dissertation, the survey principally tested whether the conclusions in the literature and the investigation of the case study were typical in both context and execution of wider UK Enterprise Architecture practice. Much useful additional information was also collected. Principal questions the survey asked included:

- What success factors have organisations experienced as a benefit of establishing an EA practice? Which benefits from Enterprise Architecture have accrued to the organisation as a whole?

- Extent of use of TOGAF as an EA framework – and its use relative to other IT Governance tools (e.g. ITIL, CoBIT).

- Whether TOGAF is adapted or customised when adopted as an EA framework.
Which stakeholders most often interact with an organisation’s EA function?

The results of the questions which asked about the benefits of Enterprise Architecture are summarised in Figure 10.

These results largely validated claims discussed in the literature review. Responses to being questioned about the success factors as applied to the implementation of IT that have resulted from an EA initiative included:

- Over 85% of respondents believed that EA had at least some benefit on overall IT Governance (35%.believing it had a significant impact)

- Over 85% of respondents believed that EA had at least some benefit in improving the working relationship between business and IT (nearly 50%.believing it had a significant impact)

- More respondents believed EA had little effect on both introducing new architecture (e.g. SOA) and simplifying infrastructure than believed it had a significant impact – with most saying there had been some benefit
Responses to the wider benefits of EA to the organisation are summarised in Figure 11.

![Bar chart showing responses to the wider benefits of EA to the organisation.](chart.png)

**FIGURE 11 - Wider Benefits of EA to Organisation**

Key findings included:

- The top three factors (when significant impact and some benefit responses were combined) were: increasing IT’s added value; enabling new business strategy or re-engineering; reduce overall IT costs

- 63% of respondents believed that EA enabled better risk management

- The factors where the majority of respondents believed EA had little effect were: more effective purchasing practices and improving offshoring/outsourcing relationships

These responses bear out the literature’s conclusions that Enterprise Architecture is regarded as improving IT’s overall efficiency and its relationship with the business.

Other survey responses suggest that the case study in the dissertation is representative of the respondents’ experiences.
• There is a wide knowledge and experience of TOGAF – 27% used TOGAF successfully and 46% had used it in the past. Only 27% of the respondents said they did not use TOGAF. However, 62% of respondents reported amending or adapting the framework.

• The only other types of EA framework that compared in levels of usage with TOGAF were those that were ad-hoc and developed in house. Zachman and proprietary methodologies were unused by more than 60% of the respondents.

• The only IT Governance framework that had widespread mandatory usage was ITIL. CoBIT was only used significantly by slightly over 20% of the respondents. PRINCE2 was used by most respondents – with nearly 60% reporting its use as widespread. There was little knowledge of ISO 38500 (Corporate IT Governance standard) – only 16% respondents had used it at all.

The survey gave a list of 14 different types of stakeholders and asked how frequently the Enterprise Architecture function interacted with each.

The radar diagram in Figure 12 shows the types of stakeholders with which the most frequent interaction was achieved (‘very frequent’, ‘often’ and ‘occasionally’).
The radar diagram in Figure 13 shows the types of stakeholders with which the least frequent interaction was achieved (‘rarely’ and ‘never’).

- The stakeholders with most frequent interaction, with over half respondents reporting it as ‘very frequent’, were Enterprise Architects and Solution Architects. Other stakeholders where ‘very frequently’ achieved the highest number of responses were: CIO/IT Director and IT Project Management.

- Less frequent but still substantial interaction was reported with some stakeholders outside the IT organisation. If ‘very frequently’ and ‘often’ responses are combined as a significant level of interaction this then includes Senior Business Management (65%) and Business End Users (70%). 30% of respondents reported interacting often with Board Members although a similar level of interaction with the CEO was rare (10% when very frequent and often responses were combined).
6. DISCUSSION AND CONCLUSIONS

My research question was:

‘To what extent does the involvement of stakeholders affect the success of applying TOGAF as an IT Governance framework in the early design stages of an SOA development?’

This question was supported by a number of research hypotheses (see Chapter 3) which were addressed through the analysis of the case study using the POE framework and surveying Enterprise Architecture practitioners.

6.1. MAIN RESULTS

In the light of the results from the study, the four hypotheses formulated in support of the research question are revisited below:

6.1.1. Stakeholder Involvement

H1: Stakeholder involvement is a key success factor in an Enterprise Architecture initiative.

The project mapped stakeholder involvement using the POE process pattern both in the recommended TOGAF process and in the process that was actually carried out in the case study.

As might be anticipated from a generic framework, TOGAF demonstrated engagement with all significant stakeholders in the project, although analysis using POE suggests that validation could be built into the process more formally and frequently.

The case study project successfully followed the steps recommended in the TOGAF process but had failed to involve the recommended stakeholders in each step, most notably the Business Strategic stakeholders, such as non-IT board members and senior line-of-business managers. The first point at which these stakeholders became involved in the project was at the final step, when they were asked to approve work
on the next phase of the project (defined by TOGAF Phase B – Business Architecture).

Analysis of the generic TOGAF process and the case study using POE suggested that the most successful elements of Enterprise Architecture initiatives are those that most closely factor in stakeholder involvement.

6.1.2. BUSINESS PROCESS EXPERT INVOLVEMENT

H2: Close engagement with business process experts is useful in identifying candidates as services for SOA

Detailed analysis of the case study confirmed the importance of close engagement with business process experts in an SOA development. Even when involvement of strategic business stakeholders was found to be insufficient in the analysis of the case study, it was found that the Enterprise Architecture initiative was able to engage with business specialist stakeholders to provide and validate specialist domain expertise.

While the survey results also confirmed the case study’s conclusion that the ability to regularly consult all stakeholders is often problematic in practice, it also confirmed that business specialist stakeholders were involved often or very frequently in more than half of all responses. Specialist domain business knowledge is something valuable for effective SOA design.

However, access to strategic business stakeholder was reported as much less frequent (e.g. CEO, board members) while it was more common with most stakeholders within the IT department (although not all).

6.1.3. APPLICABILITY OF POE IN THIS CONTEXT

H3: POE can be applied to capture stakeholder involvement in key processes of an Enterprise Architecture initiative

Both the TOGAF generic process and the case study project were able to be successfully modelled using POE. Both were able to be examined using the POE process pattern, with its separation of problem and solution exploration and validation
and its emphasis on the importance of stakeholder involvement. The use of POE highlighted inconsistencies and inefficiencies within the processes that would be likely to result in greater risk.

Problem validation only occurred at one stage in the case study process (once the whole of the problem exploration phase had been completed, unlike in the TOGAF model where an earlier validation point was recommended). Solution validation occurred, at the end of the solution exploration phase, which also marked the only formal involvement of strategic business stakeholders.

Therefore POE was an effective framework for analysing the involvement of stakeholders, although the project suggests that the POE process model could require some modification in order to represent the iterative nature of stakeholder involvement in IT governance (see below).

6.1.4. USING POE TO REASON ABOUT RISK

H4: POE can be used to reason about risk in those processes

The POE framework’s emphasis on increased risk as the likely outcome of deficiencies in the modelled business processes allowed the implications of lack of stakeholder involvement to be analysed in terms that related to the potential implications for the success of IT Governance.

Both the validation points occurred at the end of each phase, rather than validation occurring as an ongoing activity during the exploration phases. This meant that had validation failed (being rejected by the strategic stakeholders at their limited points of contact) then the project would have had to return to very early phases to refine and rework its problem definition and solution. This represents a high risk of wasted effort being expended on non-implementable solutions.

The iterative requirement to consult with different levels of stakeholders and the sometimes contradictory information received from the same business area demonstrates the risk inherent if communication is not frequently maintained with all stakeholders in the project.
6.2. ADDITIONAL RESULTS

The survey’s principal results confirmed that TOGAF was the most widely used framework among the sample of Enterprise Architecture practitioners with the majority reporting that TOGAF (or at least an adaptation of the framework) had played a role in their Enterprise Architecture initiatives.

The survey respondents generally supported the justifications for the use of TOGAF and Enterprise Architecture in general by reporting that it had better enabled deployment of new business processes, increased IT’s added value and improved risk management.

I have concluded that close involvement and management of stakeholders is a key factor in applying TOGAF. In particular, the evidence suggests that stakeholder management needs to be approached iteratively and that steps in a project may need to be repeated according to the seniority and expertise of the stakeholders.

The atomisation of individual stakeholders within an organisation and the frequent absence of any cross-organisational governance structures below board level can lead to conflicting interests being expressed by stakeholders, even within the same line-of-business or organisational structure (Pittinsky, 2010). Therefore, Enterprise Architecture practitioners may need to perform several iterations of a TOGAF step after encountering differing stakeholder views during a project. This is particularly true if, as in the ECA project, the initial contact is made with specialist stakeholders with the interests and priorities of strategic stakeholders only considered late in the process.

TOGAF makes an assumption that all levels of stakeholder within a certain category can be involved in a particular phase and does not explicitly take account of a need to perform several iterations of a step when additional significant information is obtained from stakeholders.

The POE process model, as described in the literature review, also represents a template that necessarily describes, for simplicity, a single iteration of problem, although it the processes in the pattern may be iterated many times. When many
stakeholders are involved then validation of an exploration activity may also be iterative. In practice, any application of POE will require repeated applications of this pattern through iteration, either in parallel or fractally.\(^{18}\)

Figure 14 represents how such an instantiation of the POE process model might be represented.

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This research has confirmed that several iterations of the POE process pattern were required in solving the problem in the case study. However, the current POE model could be interpreted as implying that there is a single validation for each problem exploration. However, as this research has shown, if there are a large number of stakeholders with complex relations then this may require many validations for the same exploration step. This is an issue already acknowledged by Rapanotti and Hall (2010) who recognise that a revised representation of the POE process pattern may be necessary.

This research has found that the POE process pattern is a valid method of analysing the case study and exposing deficiencies in practical implementation of the TOGAF methodology. However, the need to perform several iterations of problem and solution exploration and validation suggests that it may be of practical use to represent multiple instantiations of the POE process in a diagrammatic form.

6.3. LIMITATIONS AND CRITIQUE OF THE STUDY

6.3.1. CASE STUDY

Analysis of the case study was made by reviewing contemporaneous documentation and the direct experiences of the author. However, due to the level of detail the analysis was necessarily restricted in scope. It is also possible, because one case study was used, that some stakeholder behaviour was motivated by causes unconnected with Enterprise Architecture process, for example financial or personal considerations. However, the use of the survey to obtain views from other Enterprise Architects should mitigate this risk.

Using a case study necessarily focused the investigation on to a small subset of TOGAF, which is an extensive framework with many different types of resources available. The research addressed Phase A of the TOGAF Architecture Development Methodology (ADM) – the Architecture Vision – and it is possible that different results could be obtained from case studies which implemented other parts of the ADM or other elements of TOGAF. However, the Architecture Vision is a crucial element of TOGAF as it determines the principles and direction which is followed in
subsequent phases. Therefore, it might be considered that the most typical phase of the TOGAF ADM was investigated.

The release of TOGAF used in the case study was TOGAF 8 while the literature review discussed the most recent release, TOGAF 9 (issued in 2009). However, Phase A (as used in the case study) did not change substantially between these two releases.

The analysis has identified various factors that affected the application of TOGAF in the case study under investigation. As Problem Oriented Engineering was used as a tool to examine the TOGAF process it is possible that the factors that were most closely identified are those which the POE process pattern concentrates upon: including stakeholder management and risk management. It is possible that other techniques of investigating the case study may have emphasised other factors.

However, the use of a survey to investigate how much the case study could be generalised into more widespread Enterprise Architecture practice has addressed these concerns to a large extent.

6.3.2. Survey

The survey was completed by a self-selected sample of Enterprise Architecture practitioners and it is possible that there could be an inbuilt bias in the sample of the population that responded. Firstly, all respondents were members of the Corporate Infrastructure Forum which may draw its membership from organisations with more traditional corporate IT departments. Secondly, the respondents showed interest in responding to the survey and had the time available to do so. These respondents may, therefore, represent organisations that are more likely to follow methodological processes, such as TOGAF (as opposed to organisations that follow ad-hoc processes). However, the large number of respondents who cited use of TOGAF suggests that the evidence would still be typical of current practice in spite of any bias.
6.3.3. **SELF-REFLECTION**

I have advanced my own learning in a number of areas while conducting this project.

Firstly, I have confirmed, through the review of the literature that I have been generally aware in my own Enterprise Architecture practice of the range of methodologies and best practices that have been successfully adopted within the Enterprise Architecture practitioner community.

Also, by examining a case study which was based on a practical adaptation of the leading Enterprise Architecture framework (TOGAF), I have proved that my own practice, although requiring some improvement, has been based on techniques that have stood up to detailed scrutiny, at least within the terms of reference of the research question.

Problem Oriented Engineering has proved to be a robust and adaptable framework for the assessment of my own practice. Use of its methodology has enabled me to formally expose deficiencies in areas of Enterprise Architecture practice which I had previously only intuited, such as the dangers and risks of moving too rapidly to solution exploration without having fully explored the underlying problem. These conclusions will make it likely that I will continue to use TOGAF in my professional practice and also look for suitable opportunities where I might also employ POE.

6.4. **FUTURE RESEARCH**

The following suggested topics may extend the research carried out in this dissertation or further illuminate its research findings:

- Other phases of the TOGAF ADM could be considered for analysis
- A follow-up survey could be carried out after a period of time to gauge the success of Enterprise Architecture over a longer period of time
- Findings of the survey that have not been discussed in this dissertation could be investigated further, for example more research into the benefits and success factors of Enterprise Architecture
• A reworked POE process pattern partially derived from the conclusions of this research could be tested on further case studies

• The role of stakeholder validation could also be investigated in the application of other IT Governance frameworks
7. REFERENCES


http://problemoriented.wikispaces.com/ accessed 16th March 2010


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9. APPENDICES

9.1. APPENDIX 1 – EXTENDED ABSTRACT

INTRODUCTION

Enterprise Architecture is a discipline which provides the ability to effectively manage and co-ordinate the organisation and deployment of IT solutions and applications to meet an organisation’s business requirements and to achieve its strategic goals. Service Orientated Architecture is an architectural style which complements the premise that Enterprise Architecture should primarily align IT with business requirements.

TOGAF is a leading framework which provides a selection of tools and best-practice methodologies for Enterprise Architecture practitioners. However, it is a relatively new development, especially version 9 (the latest release). TOGAF also has its roots in a technical approach and, while in its latest releases, it urges close and wide stakeholder involvement in Enterprise Architecture. However, as a methodology, there is a risk that TOGAF may be too theoretical and idealistic perspective which may be unrealistic when implemented in pragmatic real-life situations.

Problem Oriented Engineering (POE) is a problem solving methodology which places emphasis on stakeholder involvement in problem and solution exploration and validation and explores the consequent risks. My project used POE to examine whether TOGAF’s involvement of stakeholders in IT Governance in an SOA development based on a case study based on the author’s own experience applying TOGAF to the initial stages of a project in a UK FTSE-100 company.

METHOD

I analysed a small, specific process in detail, comparing theoretical, prescriptive processes as found in TOGAF as a governance framework and those that have been observed to have occurred in practice, using the evidence gathered in research.

This case study was analysed in two ways:
- It was tested against the recommended best practice of the TOGAF Enterprise Architecture Framework

- POE was used as a framework to examine both the implementation of the case study as it was implemented and also how its implementation might have been guided using the TOGAF framework.

An online survey was also carried out among Enterprise Architecture practitioners which aimed to give an indication of whether the results of the case study were more widely applicable.

**RESULTS**

Analysis of the case study concluded that the project had successfully followed the steps recommended in the TOGAF process but had failed to involve the recommended stakeholders in each step, most notably the strategic business stakeholders, such as non-IT board members and senior line-of-business managers. The first point at which these stakeholders became involved in the project was at the final step, when they were asked to approve work on the next phase of the project.

The project in the case study first concentrated upon problem finding and then moved on to solution finding. However, problem validation only occurred at one stage in the process (once the whole of the problem exploration phase had been completed, unlike in the TOGAF model where an earlier validation point was recommended). Solution validation occurred at the end of the solution exploration phase which also marked the only formal involvement of strategic business stakeholders.

The survey’s principal results confirmed that TOGAF was the most widely used framework among the sample of Enterprise Architecture practitioners with the majority reporting that TOGAF (or at least an adaptation of the framework) had played a role in their Enterprise Architecture initiatives.

The survey respondents generally supported the justifications for the use of TOGAF and Enterprise Architecture in general by reporting that it had better enabled deployment of new business processes, increased IT’s added value and improved risk management.
**Analysis**

As both the validation points occurred at the end of each project phase, rather than validation occurring as an ongoing activity during the exploration steps, this ran the risk that had validation failed (being rejected by the strategic stakeholders at their limited points of contact) then the project would have had to return to its very early steps to refine and rework its problem definition and solution. This represents a high risk of wasted effort expended on non-implementable solutions.

The iterative need to consult with different levels of stakeholders and the sometimes contradictory information received from the same business area demonstrates the risk inherent if communication is not frequently maintained with all stakeholders in the project.

However, the survey results also confirmed the case study’s conclusion that the ability to regularly consult all stakeholders is often problematic in practice. Access was more frequent to most stakeholders within the IT department (although not all). Specialist business stakeholders are involved often or very frequently in more than half of all responses. Specialist domain business knowledge is something valuable for effective SOA design. However, strategic business stakeholder is much less frequent (e.g. CEO, board members).

**Discussion**

This research has confirmed that several iterations of the POE process pattern were required in solving the problem in the case study. This is partly because the atomisation of individual stakeholders within an organisation and the frequent absence of any cross-organisational governance structures below board level can lead to conflicting interests being expressed by stakeholders, even within the same line-of-business or organisational structure.

Therefore, Enterprise Architecture practitioners may need to perform several iterations of a TOGAF step after encountering differing stakeholder views during a project. This is particularly true if, as in the ECA project, the initial contact is made
with specialist stakeholders with the interests and priorities of strategic stakeholders only considered late in the process.

However, the current POE model could be interpreted as implying that there is a single validation for each problem exploration. However, as this research has shown, if there are a large number of stakeholders with complex relations then this may require many validations for the same exploration step. A revised representation of the POE process pattern may be necessary.

It was possible to use the POE process pattern to model the case study, proving that POE could be successfully applied to the Enterprise Architecture, which is a discipline in information technology that requires a significant amount of human, management and political interaction.

Future research might seek to extend the application of POE into other ‘softer’ areas of the application of technology. Repetition of similar research may address one of the limitations of this project which was its close focus on one relatively small project.
9.2. APPENDIX 2 – SURVEY FORM

ENTERPRISE ARCHITECTURE FRAMEWORKS QUESTIONNAIRE

Enterprise Architecture (EA) is often portrayed as being the meeting point between an organisation’s IT strategy and its business strategy – an organisation’s effectiveness depending upon specifying the optimal IT architecture to support its business model and deploying effective IT Governance for successful execution.

A number of Enterprise Architecture frameworks and methodologies have been developed. How are these used in practice? Does their influence spread outside the Enterprise Architecture department into the wider IT community and do they touch business areas whose processes they seek to improve? Does Enterprise Architecture improve IT best practice and create value for the organisation as a whole and are there practical tools that can assist in EA practice?

ENTERPRISE ARCHITECTURE FRAMEWORKS

Is your organisation’s IT strategy:

- Widely implemented and understood through the organisation
- Used for decision making within the IT department
- Implemented on an ad-hoc basis, project-by-project
- Do not have an IT strategy
To what extent does your organisation use the following EA frameworks?

<table>
<thead>
<tr>
<th></th>
<th>Use successfully</th>
<th>Have used</th>
<th>Do not use</th>
<th>Would not use</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOGAF</td>
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<td></td>
</tr>
<tr>
<td>Zachman</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proprietary consultancy (e.g. IAF)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ad hoc, developed in house</td>
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<tr>
<td>Other</td>
<td></td>
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</tr>
</tbody>
</table>

Comments (e.g. any specific adaptations of a framework)

As well as Enterprise Architecture frameworks or methodologies, which other IT governance frameworks or methodologies are used within your organisation?

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<tr>
<th></th>
<th>Mandatory Use</th>
<th>Widespread Use</th>
<th>Ad hoc use</th>
<th>No use</th>
<th>Don’t know</th>
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<tr>
<td>CoBIT</td>
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</tr>
<tr>
<td>PRINCE2</td>
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</tr>
<tr>
<td>ISO (Information Security)</td>
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<tr>
<td>ISO 38500 (Corporate IT Governance)</td>
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<td>CMMI</td>
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<tr>
<td>Other</td>
<td></td>
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</tbody>
</table>

If ‘other’ please specify
SUCCESS OF USAGE OF ENTERPRISE ARCHITECTURE FRAMEWORKS

In your Enterprise Architecture practice how frequently do you interact with the following types of stakeholder?

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Very frequently</th>
<th>Often</th>
<th>Occasionally</th>
<th>Rarely</th>
<th>Never</th>
<th>Stakeholder not applicable</th>
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<tbody>
<tr>
<td>CEO</td>
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<tr>
<td>CIO/IT Director</td>
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<tr>
<td>Senior Business Management</td>
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</tr>
<tr>
<td>Business End Users</td>
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</tr>
<tr>
<td>Enterprise Architects</td>
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</tr>
<tr>
<td>Solution Architects</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>IT Service Delivery</td>
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<td></td>
</tr>
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<td>IT Operations</td>
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<td>IT Purchasing</td>
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<td>IT Security</td>
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<tr>
<td>Suppliers</td>
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</tbody>
</table>

In your experience which of the following are factors that have made the EA department or EA initiatives a success?
<table>
<thead>
<tr>
<th></th>
<th>Significant Impact</th>
<th>Some Benefit</th>
<th>Little effect</th>
<th>None</th>
<th>Don’t know/Not applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved IT governance (e.g. Architecture board)</td>
<td></td>
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<td></td>
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<tr>
<td>Improved working relationship between business and IT</td>
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<td></td>
<td></td>
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<tr>
<td>Increased IT agility</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Allowed more effective introduction of new architectures (e.g. SOA)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduced complexity of IT architecture</td>
<td></td>
<td></td>
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<tr>
<td>Simplified infrastructure</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Please add comments

To what extent has the practice of Enterprise Architecture contributed the following benefits to your organisation?

<table>
<thead>
<tr>
<th></th>
<th>Significant Impact</th>
<th>Some Benefit</th>
<th>Little effect</th>
<th>None</th>
<th>Don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enabled deployment of new business strategy/ re-engineering business</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduced overall IT costs</td>
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<tr>
<td>Increased IT’s added value</td>
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<td>More effective purchasing practices</td>
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<tr>
<td>Improved offshoring/outsourcing relationships</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Improved management information</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enabled more effective regulatory compliance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Better risk management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Which tools does your organisation use for Enterprise Architecture?

- Adaptive Enterprise Architecture Manager
- Alfabet
- Casewise
- IBM/Telelogic System Architect
- IDS Scheer ARIS
- Mega
- Microsoft Excel
- Microsoft Powerpoint
- Microsoft Visio
- Sparx Enterprise Architect
- Troux Technologies
- Other

If ‘other’ please specify
9.3. APPENDIX 3 – SURVEY RESULTS

1. Is your organisation’s IT strategy:

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Response Percent</th>
<th>Response Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Widely implemented and understood throughout the organisation</td>
<td>32.4%</td>
<td>12</td>
</tr>
<tr>
<td>Used for decision making within the IT department</td>
<td>48.6%</td>
<td>18</td>
</tr>
<tr>
<td>Implemented on an ad-hoc basis, project-by-project</td>
<td>16.2%</td>
<td>6</td>
</tr>
<tr>
<td>Do not have an IT strategy</td>
<td>2.7%</td>
<td>1</td>
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</tbody>
</table>

Comments: 9 answered question, 37 skipped question
2. To what extent does your organisation use the following EA Frameworks?

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Use successfully</th>
<th>Have used</th>
<th>Do not use</th>
<th>Would not use</th>
<th>Response Count</th>
</tr>
</thead>
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<td>10</td>
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<td>37</td>
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<tr>
<td>Zachmann</td>
<td>0</td>
<td>7</td>
<td>20</td>
<td>2</td>
<td>29</td>
</tr>
<tr>
<td>Proprietary consultancy (e.g. IAF)</td>
<td>1</td>
<td>8</td>
<td>18</td>
<td>1</td>
<td>28</td>
</tr>
<tr>
<td>Ad-hoc developed in-house</td>
<td>11</td>
<td>11</td>
<td>10</td>
<td>3</td>
<td>35</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>3</td>
<td>12</td>
<td>3</td>
<td>18</td>
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</tbody>
</table>

Comments / other frameworks or adaptions: 16

answered question 38

skipped question 0
3. Have you adapted or amended the framework in use in any way within your organisation?

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Response Percent</th>
<th>Response Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>62.2%</td>
<td>23</td>
</tr>
<tr>
<td>No</td>
<td>13.5%</td>
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<tr>
<td>Not applicable</td>
<td>24.3%</td>
<td>9</td>
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</tbody>
</table>

Comments: 10

- answered question 37
- skipped question 1
4. As well as Enterprise Architecture frameworks and methodologies, which other IT governance frameworks or methodologies are used within your organisation?

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Mandatory use</th>
<th>Widespread use</th>
<th>Ad hoc use</th>
<th>No use</th>
<th>Don't Know</th>
<th>Response Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>ITIL</td>
<td>12</td>
<td>11</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td>33</td>
</tr>
<tr>
<td>CoBIT</td>
<td>2</td>
<td>4</td>
<td>9</td>
<td>10</td>
<td>3</td>
<td>28</td>
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<tr>
<td>PRINCE2</td>
<td>4</td>
<td>19</td>
<td>8</td>
<td>2</td>
<td>0</td>
<td>33</td>
</tr>
<tr>
<td>ISO (Information Security)</td>
<td>6</td>
<td>10</td>
<td>6</td>
<td>3</td>
<td>5</td>
<td>30</td>
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<tr>
<td>ISO 38500 (Corporate IT Governance)</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>11</td>
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<td>24</td>
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<td>3</td>
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<td>6</td>
<td>9</td>
<td>28</td>
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<tr>
<td>Other</td>
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<td>0</td>
<td>2</td>
<td>2</td>
<td>12</td>
<td>18</td>
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</table>

Comments / Other frameworks: 3

33 answered question
5 skipped question
5. In your EA practice how frequently do you interact with the following types of stakeholders?

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Very Frequently</th>
<th>Often</th>
<th>Occasionally</th>
<th>Rarely</th>
<th>Never</th>
<th>Not Applicable</th>
<th>Response Count</th>
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<tr>
<td>CEO</td>
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<td>2</td>
<td>10</td>
<td>9</td>
<td>6</td>
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<td>8</td>
<td>6</td>
<td>6</td>
<td>1</td>
<td>30</td>
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<tr>
<td>CIO / IT Director</td>
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<td>9</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>31</td>
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<tr>
<td>Senior Business Management</td>
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<td>11</td>
<td>9</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>31</td>
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<td>Business End Users</td>
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<td>9</td>
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<td>0</td>
<td>0</td>
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<tr>
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<td>15</td>
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<td>13</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>31</td>
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<td>14</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>1</td>
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Suppliers 7 14 8 0 0 1 30
Comments: 2 answered question 32 skipped question 6
6. In your experience, which of the following are factors that have made the EA department or initiative a success?

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Significant Impact</th>
<th>Some benefit</th>
<th>Little effect</th>
<th>None</th>
<th>Don't Know / Not Applicable</th>
<th>Response Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved IT Governance (e.g. architecture board)</td>
<td>11</td>
<td>15</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>31</td>
</tr>
<tr>
<td>Improved working relationship between Business and IT</td>
<td>15</td>
<td>11</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>31</td>
</tr>
<tr>
<td>Increased IT agility</td>
<td>5</td>
<td>16</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>31</td>
</tr>
<tr>
<td>Allowed more effective introduction of new architectures (e.g. SOA)</td>
<td>3</td>
<td>12</td>
<td>11</td>
<td>0</td>
<td>5</td>
<td>31</td>
</tr>
<tr>
<td>Reduced complexity of IT architecture</td>
<td>5</td>
<td>19</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>31</td>
</tr>
<tr>
<td>Simplified Infrastructure</td>
<td>4</td>
<td>15</td>
<td>7</td>
<td>3</td>
<td>2</td>
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<td>5</td>
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</table>

answered question: 31

skipped question: 7
7. To what extent has the practice of EA contributed to the following benefits in your organisation?

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Significant Impact</th>
<th>Some benefit</th>
<th>Little effect</th>
<th>None</th>
<th>Don’t Know / Not Applicable</th>
<th>Response Count</th>
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</thead>
<tbody>
<tr>
<td>Enabled deployment of new Business strategy / re-engineering Business</td>
<td>6</td>
<td>16</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>Reduced overall IT costs</td>
<td>6</td>
<td>15</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>30</td>
</tr>
<tr>
<td>Increased IT’s added value</td>
<td>8</td>
<td>17</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>29</td>
</tr>
<tr>
<td>More effective purchasing practices</td>
<td>1</td>
<td>9</td>
<td>16</td>
<td>2</td>
<td>2</td>
<td>30</td>
</tr>
<tr>
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answered question 30
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8. What tools does your organisation use for Enterprise Architecture (list generated from member workshops)?

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9.4. APPENDIX 4 – ORGANISATIONS RESPONDING TO SURVEY

Aviva Plc
BAE Systems Plc
Balfour Beatty plc
Cambridge Assessment
Centrica plc
European Bank for Reconstruction
Development
Friends Provident
GlaxoSmithKline plc
HM Land Registry
HM Revenue and Customs
J D Williams And Co Ltd.
John Lewis Partnership
Leicestershire County Council
National Grid
National Policing Improvement Agency
Network Rail
Office for National Statistics
Ordnance Survey
Reed Elsevier Technology Services
SABIC UK Petrochemicals Limited
Severn Trent Water
Syngenta Crop Protection AG
TUI Travel plc
Virgin Atlantic Airways Limited