PLANNING STRATEGICALLY, DESIGNING ARCHITECTURALLY: A FRAMEWORK FOR DIGITAL LIBRARY SERVICES

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Abstract

In an era of unprecedented technological innovation and evolving user expectations and information seeking behaviour, we are arguably now an online society, with digital services increasingly common and increasingly preferred. As a trusted information provider, libraries are in an advantageous position to respond, but this requires integrated strategic and enterprise architecture planning, for information technology (IT) has evolved from a support role to a strategic role, providing the core management systems, communication networks, and delivery channels of the modern library. Further, IT components do not function in isolation from one another, but are interdependent elements of distributed and multidimensional systems encompassing people, processes, and technologies, which must consider social, economic, legal, organisational, and ergonomic requirements and relationships, as well as being logically sound from a technical perspective. Strategic planning provides direction, while enterprise architecture strategically aligns and holistically integrates business and information system architectures. While challenging, such integrated planning should be regarded as an opportunity for the library to evolve as an enterprise in the digital age, or at minimum, to simply keep pace with societal change and alternative service providers. Without strategy, a library risks being directed by outside forces with independent motivations and inadequate understanding of its broader societal role. Without enterprise architecture, it risks technological disparity, redundancy, and obsolescence. Adopting an interdisciplinary approach, this conceptual paper provides an integrated framework for strategic and architectural planning of digital library services. The concept of the library as an enterprise is also introduced.

Key words Digital libraries, Information strategy, Enterprise architecture

INTRODUCTION

A key element of successful library management is strategic planning, which simply put, provides organisational direction for the enterprise. Without a clear and coherent strategic plan, a library risks being directed by outside forces with independent motivations and perhaps more importantly, inadequate understanding of a library's broader societal role (Johnson et al., 2004; Kent, 2008). However, strategic planning is acknowledged as a challenging activity for librarians, which, at times, can be time consuming and unproductive (Linn, 2008). Further, often when strategic plans do exist, they are couched in soft 'motherhood' terms, making them difficult to translate into operational plans, thus leading to ambiguous goals and objectives lacking clear measures of success. For example, a recent study which examined the strategic plans of 32 public libraries within a devolved jurisdiction of the UK, concluded that public libraries could improve not only completeness of plans (from vision statements to action plans), but also their precision, specificity, explicitness, coordination, and consistency, and overall mapping to library services (Buchanan & McMenemy, 2010). Notably, the study also found digital goals broadly and generically defined and several plans to be parent local authority plans that lacked specificity to library services.

Of associated importance to a library is enterprise architecture, which strategically aligns and holistically integrates business and information system architectures, for in an era of unprecedented technological innovation and evolving user expectations and information seeking behaviours (Brophy, 2007; Leong, 2008; Parry, 2008), solutions are often multifaceted and multiparty. For example Rogers (2007, p.375), reviewing trends in academic libraries, discusses how libraries must:

> … evaluate, obtain and support products from more and more vendors whose primary clients are not libraries; participate in development and support of technology solutions with members of open source communities; (and) partner with other campus units to deliver coherent enterprise-wide information services through architectures that simplify discovery and navigation for an increasingly mobile population…

Brophy (2007, p.17) argues that rapid and complex technological change is where the biggest challenges lie for the library, and worryingly, suggests that librarians 'have not developed the skills to understand it, exploit it or create it'. Whether this is true or not there is certainly limited empirical evidence

of enterprise architecture applied within the library domain, and yet without enterprise architecture, a library, like any other organisation, is at risk of technological disparity, redundancy, and obsolescence.

This chapter provides a framework for strategic planning, which, in acknowledgment of emerging digital services now increasingly common and increasingly preferred (Tonta, 2008), pays particular attention to information strategy and the relationship to enterprise architecture. The importance of a holistic approach is emphasised, with established methods and tools applicable to libraries highlighted.

DIGITAL LIBRARY SERVICES

Simply put, a digital library is a collection of digital content. However, the DELOS Network of Excellence on Digital Libraries (DELOS, 2007, p.15), describing the digital library as 'a tool at the centre of intellectual activity having no logical, conceptual, physical, temporal or personal barriers on information', have argued that digital libraries, in pursuit of personalised interactive user experiences, have evolved from content-centric systems to person-centric systems, with the role of the digital library having 'shifted from static storage and retrieval of information to facilitation of communication, collaboration and other forms of collaboration'. Arguably inherent within such a role is the provision of digital services, which go beyond simple provision of content.

Digital services can be considered as those services or resources accessed and/or provided via digital transaction (Williams et al., 2008). Services can range from the relatively straightforward, such as provision of online tools and virtual space for collaboration, sharing of content etc., to online reference services, and to more complex distributed and interactive systems such as digitized local archive collections purposefully linked to a local school curriculum's via virtual learning environments. In the role of access provider a digital library will also establish links to other public information providers with which it shares societal goals such as lifelong learning and health and wellbeing (for example, across education, health, and the arts), which may appear straightforward, but in practice are not so, for there are underlying information architecture implications and associated usability issues to consider, not the least of which is how to provide seamless access and interaction (Buchanan & McMenemy, 2010). However, a more significant associated challenge is that presented by dynamic and distributed multimedia content now inherent in many digital services. This, combined with rapid technological advancement and change, presents significant

challenges for sustainable long-term digital preservation and access, a particular issue being how to capture and represent contextual information to preserve authenticity and integrity (Watry, 2007; Chowdhury, 2010).

Such trends and associated challenges raise a number of questions that emphasise the importance of planning strategically, and designing architecturally. In particular: w*hat* digital services, with *who*, and perhaps most challenging of all, *how*?

STRATEGY

Without strategy a library will lack organisational cohesion, shared values, and common goals. Under such circumstances, library initiatives could be introduced independently of one another, encouraging division, and potentially leading to disparity and duplication, particularly at the national and/or regional level, and across collaborative partnerships such as those increasingly found between libraries, museums and archives. At best, the closest a library will come to exploiting natural synergy and demonstrating value will be at the operational infrastructure level, but even this will be difficult to confirm without strategic direction and associated goals and measures.

The components of a strategic plan

Although no standard definition of a strategic plan exists, often when strategy is discussed, reference is variously made to vision, mission, goals, objectives, and courses of action (Koch, 2000). It is important to note that these are not synonymous terms, but discrete components of an articulated strategy:

Vision: is a top-level statement of what an organisation aspires to, embodying associated core values (e.g. lifelong learning). Vision statements typically set high expectations with a long-term focus (for example, Glasgow's (2006) cultural strategy aspires to 'establishing a city of dynamic, successful, and connected communities where all forms of learning are recognised and valued'.

Mission: provides the vision statement with context. Also top-level (and often generalised to be more enduring), they provide an operational statement of what the organisation wants to do, typically focused on provision of services to particular market segments, or highlighting key activity (e.g. developing community learning hubs).

Goals: goals are statements about a particular end state that the organisation wishes to achieve over the medium to long term (e.g. providing a city wide collection and catalogue). Goals are more dynamic than mission or vision statements, as they must respond to market forces, and evolve to take advantage of *ad hoc* opportunities. They include targets and milestones.

Objectives: are specific, quantifiable and attainable short-term targets, which are used to measure the degree to which the organisation is realising its goals. Objectives are time-limited, and associated with unambiguous and measurable criteria for success (e.g. increasing participation and audience development).

Courses of action: define the specific steps to be taken to realise goals and objectives, typically realised as a project plan. Action plans can be strategic (long-term) or tactical (short-term), but are typically short-term towards longer-term goals (e.g. developing integrated public and educational information services, creating digital heritage collections, expanding particular outreach activities).

Notwithstanding previously noted issues regarding lack of library specific plans, it is important to note that strategy can legitimately coexist at both the corporate level and unit level. Corporate level strategy, developed by the executive with input from senior management, focuses upon high-level direction, mid to long-term market position, and partnerships. Unit or divisional strategy, developed by managers of the respective units, provides operational direction at the divisional level, and is focused upon customer service/segment and tactical responses to more dynamic and immediate market forces. Key to the existence of multiple levels of strategy is to ensure that they are hierarchical, with goals and objectives traceable back to the 'parent' strategy (for example, the parent of an academic library strategy would be the university strategy, for a public library, the local authority strategy).

Strategic plans are also supported by policy, which provides more enduring operational guidelines, including boundaries and constraints. Focused upon internal processes and procedures (e.g. collection policies for digital and repository initiatives), including legal and regulatory requirements, policy shapes and influences courses of action. Guidelines are predominantly 'hard', motivated by legal or productivity goals, but are also influenced by 'soft' factors, such as customer expectations, and moral and ethical considerations.

The strategic planning process

Strategic planning is typically initiated by regular planning cycle or review process (between 1-5 year cycles). However dynamic market forces and new technology will continually influence and shape future directions. As a consequence, strategic planning should actually be considered a continuous process, which allows longer term plans to evolve or be revisited between cycles.

Various strategic planning processes have been proposed, but although terminology differs across authors there is underlying commonality of purpose and broad applicability. For example, Chaffey (2002), writing for e-business, proposes a four-stage process of *strategic analysis* (environmental scanning and the assessment of existing capabilities and assets), *strategic objectives* (stating the vision, mission, goals and objectives), *strategic definition* (option generation, evaluation and selection), and *strategic implementation* (planning, execution and control). Roberts and Rowley (2004), writing for information services management, propose a similar but three-stage process of *strategic analysis and audit* (external environment and internal resources), *strategic choice* (objectives, options and choices), and *strategic action and implementation* (planning, resource allocation, monitoring and control). Allison and Kaye (2005), writing for non-profit organisations, break the planning process down into seven stages: *get ready* (setup), *articulate mission, vision, and values* (strategic direction), *assess your situation* (internal and external analysis), *agree on priorities* (core strategies, long-term goals and objectives), *write the plan* (strategic plan), *implement the plan* (annual plan and operating guidelines), and *evaluate and monitor the strategic plan* (cyclical evaluation and revision). Through high-level comparison, a four stage generic process of *analyse*, *formulate*, *implement*, and *evaluate* can be identified (see Figure 1).

Take in Figure 1

In the *analyse* stage, analysis of external and internal factors is undertaken to evaluate organisational performance, and 'proof' new concepts/initiatives. External analysis will include: evaluation of international and local trends, drivers, and barriers; local market segmentation and services assessment; and opportunity analysis. Internal analysis will include: organisational appraisal, including 'strategic fit' of new concepts/initiatives; and organisational readiness review, with particular regard to capability and competency, which will include infrastructure, process, and resource considerations.

In the *formulate* stage, concepts are developed into plans, dependent upon the outcome of the analyse stage (which will influence direction, budget, etc.). Formulate will typically begin with more

detailed analysis and development of the value proposition, including gap analysis, vision and objectives, and options and risks. In this stage various scenarios may be explored to identify a preferred course of action. Once identified, the next step will be to specify (where applicable): target market segments, sales and distribution channels, customer management, financial implications, 'fit' within current services roadmap, and key organisational factors, such as process implications. This stage will also include communication of vision to gain organisational commitment, and to clearly align courses of action with overall corporate strategy.

In the *implement* stage, the program of work/action is developed, including more detailed budget formulation and allocation. It is common to find a further budget check at this point, re-confirming costs once more detailed requirements are known/specified. Upon successful initiation of the program of work, concepts are tracked to implementation from both an operational and strategic perspective. In simple terms, operational aligns with typical project management roles and responsibilities, while strategic ensures continued alignment with overall vision, objectives, and measures.

In the *evaluate* stage, outcome is measured, which will involve cost benefit analysis, market surveys, and process/service benchmarking etc. It is important to note that effective library evaluation will employ both quantitative and qualitative techniques (McMenemy et al., 2008), balancing output oriented performance indicators (e.g. stock turnover, borrowing figures) with social audit methods extending beyond usage to social utility (e.g. personal development, social cohesion). Dependent upon the initiative, the timescale for measurement will typically range from three to twelve months, with results forming the foundation of the learning loop, contributing to further cycles of strategic planning.

In traditional strategic planning cycles, strategy, as dictated by market goals and forces, has driven resource procurement, development, and management, with associated information resources (e.g. technology, applications) often considered part of infrastructure support. However, in today's online, digital world, this relationship has evolved to become more mutually dependent, for technology can shape and influence strategy, opening up new markets and services, and offering opportunity for differentiation and innovation in existing markets through enhanced offerings and additional delivery channels. Further, in the digital age, information is often *the* commodity, and technology often *the* delivery process. In such circumstances, attention is drawn to the importance of information strategy.

Information strategy

Information strategy provides overarching direction and operational guidance for the effective deployment and management of an organisation's information resources. Earl (1989, 2000) identifies four properties of information strategy: management, technology, systems, and resources. However, Gibb et al. (2006) argue that Earl's use of the term 'information resource' is perhaps unfortunate in that there has been a long-standing use of the term information resource to refer to all of the resources used to exploit information: information personnel, technology, systems and content. They propose that a more appropriate term would be 'content strategy' associated with the related activity of enterprise content management. The adapted model is illustrated in Figure 2.

Take in Figure 2.

It should be emphasised that the distinctions made between these four properties to some degree represents an ideal, for in reality, the size of an organisation or its attitude to information resources may blur boundaries. However, Earl's (1989, 2000) model is important in making the distinction between the technologies needed for processing information, the applications which support or instantiate these processes, the information generated or consumed, and the over-arching management of these resources.

Information technology (IT) strategy is concerned primarily with technological issues such as architecture, standards, physical security, data integrity, service availability and maintenance, support and procurement. It is therefore answering the 'how' question, e.g. how will we deliver digital services? This covers desktop platforms, peripherals, networks, servers and other shared computer processing capability and repositories of data, operating systems and software tools. The key goal of the strategy is to ensure that there is a robust but flexible infrastructure that can support the range of applications required to satisfy organisational objectives. In an ideal world it might be argued that the strategy should be to embrace the use of an agreed set of technologies in order to simplify management, reduce costs and provide guarantees that data can be exchanged between co-operating systems. In practice, library IT managers will have to deal with legacy issues such as new technologies for which standards may not yet be agreed, purchases which take place outside procurement guidelines, and software version drift.

Information systems (IS) strategy is concerned with ensuring that systems development is in tune with organisational needs and identifying and prioritising applications for development. This requires a

focus on service and process models, data definitions, information architectures, and user needs. It is concerned with the 'what' question, e.g. what application set is required to meet service objectives. The IS strategy will focus on enterprise-level application needs, in particular those systems which support and/or integrate end-to-end processes. This is particularly important for ensuring that data captured by customer-facing applications (e.g. customer request/renewal) can be instantly supported by data on, for instance, stock levels (from stock management and inter-library loan systems), lead-times (from publishers production management systems) and delivery times (from distributors supply chain management systems). It is desirable for all information systems to be addressed by the information systems strategy, but individual systems often justifiably exist within individual units or divisions based upon local need (for example within collaborative partnerships). In these circumstances, clear ownership is essential.

Information management strategy is concerned with identifying and specifying the roles and responsibilities necessary for the delivery, support, and development of IT, IS, and information content (IC) functions and activities. This involves establishing clear ownership and accountability for information activities and addresses the 'who' question (e.g. who resources, authorises, quality assures, tests, maintains, controls, etc.). It should also be concerned with the co-ordination of all related information resources and establishing the appropriate controls, guidelines and procedures which are necessary to ensure the quality, availability, protection and timeliness of information. This requires a clear understanding of the implications of legislation and regulations concerned with information handling. Finally, it is concerned with identifying and ensuring that the competencies needed to deliver and exploit information systems and technologies are available to the organisation. This will include in-house, contracted and outsourced activities. It will also be reflected in the need to provide appropriate training to develop and use the applications and tools.

Information content strategy is focused on content and its management encompassing all forms of media (paper, film, tape, disc, etc.) and all forms of information (image, sound, text and data). In addition, depending on the approach taken to knowledge management, it may include intellectual capital such as patents and copyrighted material. Earl (1989, 2000) suggests that this is about answering the 'where' question (where are we going?) but it is perhaps simpler to view it as another 'what' question: what information do our employees, suppliers and customers need in order for us to provide an effective service?

Information content strategy must therefore consider categorisation of information, version control, archives, documents standards, metadata for information resource description, retention and disposal policies, and information quality. Categorisation is a particularly important activity as efficient and effective retrieval and protection is predicated by effective analysis and indexing. Although libraries use standard classification systems (such as DDC or LCC) and employ cataloguing standards (e.g. MARC, ISBD, RDA), there is no single standard to which they all subscribe with differences in stock description techniques having been found to be particularly obstructive in establishing joint digital collections (Tonta, 2008; Bailey-Hainer and Urban, 2004).

Integrated Strategic Planning

Information strategy should not be considered as a parallel strategic planning activity, but as an integrated, and core part of the overall planning process. Earl (1989), when considering information strategy formulation, suggested that there are three approaches to analysis and planning (see Figure 3): a. a top-down approach which sets direction and then allocates information resource investment accordingly; b. a bottom-up approach which evaluates current information resource capability to identify and respond to gaps in provision; and c. a two-way approach which considers both current and future needs, and explores opportunity for innovation. Effective analysis and planning would encompass each of these approaches (as part of the *analyse* and *formulate* stages [see Figure 1]), allowing a library (with particular regard to information resources) to strategically identify where it wants to be, where it currently is, and what it must provide to bridge any gaps.

Take in Figure 3.

Information strategy formulation is thus both strategic and architectural in perspective, with strategic plans and future digital services shaped by the potential enabling role of new technology, and influenced by the limitations of existing legacy technology. A method to formally extend strategy formulation to architectural planning is provided by enterprise architecture.

ENTERPRISE ARCHITECTURE

Enterprise architecture extends strategic planning to IT architecture, ensuring business and technology architectures are holistically aligned, integrated, and coordinated. Beyond the strategic imperative, there are significant financial and operational benefits to be realised via an enterprise architecture, including: better returns on existing IT investments, reduced new investment risk, lower development, support, and maintenance costs, increased portability of applications, and improved ability to address critical enterprise-wide issues (The Open Group, 2006).

The library as an enterprise

Perhaps the simplest definition of an enterprise is a collection of organisational entities, which share a common goal and foundation infrastructure. The simplest example is a single organisation. However, in multi-national federated organisations, it is also valid to consider a subsidiary or division as an enterprise. It is also important to note that in today's online domain, the boundaries of an enterprise can be extended to include partners.

Across the public and private sectors, partnerships are now widely recognised, not just as a strategic option, but also in several instances as a strategic necessity (Beckett, 2005). Wildridge et al (2004, p.14) argue that in a rapidly evolving and increasingly complex global society, "partnership working is a key area for the library information professional currently, and is crucial for the profession for the future", and Brophy (2007, p.212) argues that 'Libraries cannot go it alone and their future strength will depend on the alliances they forge'. Perhaps not surprisingly therefore, library collaboration is now beginning to extend beyond archives and museums to educational institutions, social services, health services, private industry, and other cultural organisations, which share goals such as early learning, cultural heritage, and health and wellbeing. Within the digital domain, joint initiatives such as cross-institutional digital collections and shared virtual learning environments are emerging, with libraries assuming the role of both content provider and access provider. In so doing, they are establishing the library as an enterprise, with an associated architectural requirement.

The elements of enterprise architecture

Perks and Beveridge (2003, p.12) define enterprise architecture as 'the collection of strategic and architectural disciplines that encompass the information, business system, and technical architectures' of an

organisation'. The Open Group (2006), upon which Beveridge and Perks' definition is based, further define this as consisting of four subset architectures:

Business: the strategic, governance, and organisational framework and structure, and the processes, functions and roles within.

Data: logical and physical data entities, assets and data management resources.

Application: individual applications, their interactions, and relationship to business processes.

Technology: the logical and physical networks, transmission media and protocols, and hardware which provide the supporting infrastructure for business processes.

Similar to Earl's (1989, 2000) model, enterprise architecture distinguishes between the technology required to process information, the applications which support or instantiate processes, and the information generated or consumed. Notably, attention is also paid to business architecture, which defines the organisational processes, functions and roles supported by data, application, and technology architectures.

Enterprise architecture frameworks

Two often cited architectural frameworks discussed below are the Zachmann Architectural Framework, commonly considered a founding framework (Schekkerman, 2006), and The Open Group Architectural Framework (TOGAF), an open group standard supported by the practitioner community and over 200 member organisations.

The Zachman Architectural Framework. The Zachman framework (Zachman, 1987) was proposed as an approach to information systems architecture, which tackled the acknowledged, but then only partially addressed requirement for multiple stakeholder views of information system architecture. Zachman drew on proven architectural principles and processes from the construction, manufacturing, and avionics industries, to develop a framework suitable for information systems architecture. The framework provides a comprehensive and modular classification of viewpoints and models, representing and relating all stakeholder perspectives, and allowing architects to focus on selected aspects of the system without losing sight of the bigger picture. In the years since its publication it has become the de facto standard for many within the information systems architecture community.

The framework is a matrix of six columns and six rows providing thirty-six cells representing the views of information system architecture. The initial framework was made up of the first three columns (Zachman, 1987), but this was later expanded (Sowa & Zachman, 1992) to the six as illustrated in Table 1.

The rows represent the perspectives. They are:

Scope: represents the contextual view of the planner or investor who wants an estimate of the scope of the system, what it would cost, and how it would perform

Business model: represents the conceptual view of the owner who wants to understand the business model, and the relationship between entities and processes

System model: represents the logical view of the designer who must determine the data elements and functions that represent business entities and processes

Technology model: represents the physical view of the builder who must adapt the information system model to the details of the programming languages, I/O devices etc., and consider the constraints of tools, technology, and resources

Detailed representation: represents the out-of-context view of the subcontractor who typically works from detailed specifications, often at the component level.

Functioning enterprise: represents the operational system view.

Table 1. The Zachaman Framework (http://www.zifa.com)

	Data ***what***	**Function** ***how***	**Network** ***where***	**People** ***who***	**Time** ***when***	**Motivation** ***why***
Scope	List of things important to the business	List of processes the business performs	List of locations in which the business operates	List of organisations important to the business	List of events/cycles significant to the business	Lists of business goals & strategies
Business model	Semantic model	Business process model	Business logistics system	Work flow model	Master schedule	Business plan
System model	Logical data model	Application architecture	Distributed system architecture	Human interface architecture	Processing structure	Business rules model
Technology model	Physical data model	System design	Technology architecture	Presentation architecture	Control structure	Rule design
Detailed representation	Data definitions	Program	Network architecture	Security architecture	Timing definition	Rule specification
Functioning enterprise	**Data**	**Function**	**Network**	**Organisation**	**Schedule**	**Strategy**

The columns provide a set of questions, which lead to the different perspectives. They are: *what* is the system made of; *how* does the system work; w*here* are the system components and connections; w*ho* does the work; w*hen* do things happen; and w*hy* are various choices made?

Associated framework rules specify that elements (e.g. dimensions/cells) are unique, dynamically interdependent, and logically recursive. There is no order of priority or sequence, but all six dimensions are needed to fully represent each perspective (the composite or integration of all cell models in one row constitutes a complete perspective).

Zachman is a logical framework, which does not prescribe or describe any particular method, representation technique, or tool. Perhaps the simplest way to view the framework is as a basic structure for providing a set of architectural representations of an organisations' enterprise architecture. The Open Group (2006) suggested that the main strength of the framework is that it provides a way of thinking about an enterprise in an organised way, so that it can be described and analysed. Abdullah and Zainab (2008), arguing that in the field of collaborative digital libraries stakeholder needs and context of use are not usually captured comprehensively, adopted the Zachman Framework as a formal framework for digital library design. They found the framework to be particularly useful for requirements specification, providing a framework for comprehensively and systematically capturing both user need and context of use via the respective perspectives and dimensions (in particular planner, owner, and designer). The logic of the Zachman framework can be seen applied within other models, for example, the DELOS Digital Library Reference Model (DELOS, 2007) identifies four key views and associated actors: a. end users who exploit digital library functionality for providing, consuming and managing content; b. designers who define, customise and maintain the digital library; c. system administrators who identify the necessary architectural configuration and components to implement the digital library; and d. developers who develop the components of the digital library.

The Open Group Architectural Framework. The Open Group Architectural Framework (TOGAF) is an enterprise architecture development method, which can be applied at the enterprise, multi-system, or single system level of an organisation. The original version released in 1995 was based on the Technical Architecture Framework for Information Management (TAFIM), developed by the US Department of Defence. Since 1995 TOGAF has evolved year-on-year through extensive industry

consultation and user-group feedback and involvement, with the overarching goal being to establish boundary-less information flow. The framework is freely and publicly available, and has been adopted across both the public and private sector. It consists of three main parts:

Architectural Development Method: the methodology, which defines the processes required for transition from foundation architecture to organisation-specific architecture.

Enterprise Continuum: the virtual repository of architectural models, standards, and documents.

Resource Base: additional guidelines, templates, checklists, and background information.

The Architectural Development Method (ADM) is at the core of the TOGAF model, providing a systematic step-by-step approach to enterprise architecture development (see Figure 4). The model begins with preliminary setup tasks associated with scope, definition, and management processes. The next phase continues scoping and establishing the remit of the architectural exercise, but with the emphasis now on vision, strategic alignment, and organisational recognition and endorsement. The next three phases focus on systematic architectural modelling (baseline and target) of the business architecture, information systems architecture (data and applications), and technology architecture. The final four phases are concerned with solution identification and implementation (viewed as parallel rather than sequential processes). The ADM is regarded as a continuous, cyclical, and iterative process; with the first iteration regarded as the hardest, primarily due to it taking place at an initial stage of the enterprise continuum.

Take in Figure 4.

The Enterprise Continuum is a virtual repository of architectural artifacts and assets, which exists to enable architectural development. The continuum is expressed by TOGAF as a combination of two complementary architectural concepts: architectural continuum and solutions continuum.

The architectural continuum provides a way to define and understand generic architectural rules, representations, and relationships among foundation frameworks; and to discover commonality and eliminate unnecessary redundancy. Presented as an evolutionary process, which begins with the TOGAF foundation architecture, through common system architectures, and industry specific architectures, to an organisations own individual architecture (see Figure 5). This represents a progression from logical to physical, and from general to specific based upon adoption/leverage of reusable architectural components and building blocks.

The solutions continuum represents the implementation of the architecture at the corresponding levels of the architecture continuum (products and services, system solutions, industry solutions, organisation solutions). At each level, the solutions continuum is a population of the architecture with reference to building blocks, either purchased or built, that represent a solution to organisational requirement at each respective level. A populated solution continuum can be regarded as a solution inventory or reuse library, with associated benefits.

Take in Figure 5.

The enterprise continuum, at the highest level, is a conceptual model providing a logical schema for architectural analysis and design, which as an example, is applicable to the previously noted digital preservation challenge. For example, Moore (2008, p.64) has called for 'new types of storage systems, new protocols for accessing data, new data-encoding formats, and new standards for characterizing provenance', while Chowdhury (2010, p.219) asks:

> How do we create an environment – tools, techniques, standards and the appropriate IT infrastructure – so that the huge volume and variety of content can be taken from the past to the future, along with their specified users and the intended use, on a global scale?

The continuum encourages such requirements to be approached from a common perspective ensuring that solutions are industry wide. In support, TOGAF provide two sets of reference models, which provide the foundation for the continuum: firstly the Foundation Architecture which comprises a Technical Reference Model (TRM) of generic services and functions (at the generic platform level), and an associated Standards Information Base (SIB); and secondly the Integrated information infrastructure reference model (lll-RM), a subset of the TRM which provides a taxonomy of business applications and infrastructure applications required to provide an integrated information infrastructure (for example, distinguishing between the digital library system, the digital library management system, and the associated development tools).

Finally, the TOGAF Resource Base specifies the resources required to support architectural development and management, and provides a selection of guidelines, templates, and background information to support the use of the TOGAF ADM, extending to contract definition. The resource base also provides a repository of case studies, and includes guidelines for evaluating architectural tools.

In contrast to Zachman, the TOGAF framework provides a step-by-step method for architectural planning, development, and change management. While Zachman's is simple and non-prescriptive, TOGAF is detailed and to a degree, prescriptive. However, rather than viewing the frameworks as either/or approaches, they can be considered as compatible components of an overall approach. Viewed in combination, TOGAF can provide the methodological step-by-step development process, while Zachman can guide and facilitate comprehensive visualisation and representation.

FROM STRATEGY TO ARCHITECTURE

Natural synergy between information strategy and enterprise architecture models can form the basis of an integrated approach to digital library service development, ensuring that initiatives are strategically and architecturally aligned.

An integrated framework

Buchanan & Gibb (2007) have mapped a relationship from information strategy to enterprise architecture frameworks via Earl's (1989, 2000) information strategy components, as illustrated in Figure 6.

Take in Figure 6.

In Figure 6, strategic planning is shown as a two-way process, acknowledging the iterative relationship between organisational goals, current capabilities, and opportunity for technological innovation. The Zachman framework provides a method for representing the organisational and architectural entities essential to a system view, while TOGAF extends Earl's (2000) taxonomy, providing a methodology which bridges the gap between strategy formulation and architectural planning and development.

The role of the information audit

In support of the integrated framework illustrated in Figure 6, Buchanan & Gibb (2007) recommend the information audit as a practical method for identifying and evaluating an organisation's information resources, which consists of five steps (Buchanan & Gibb, 1998):

Promote: communicating the benefits of the audit, establishing commitment and cooperation, and conducting a preliminary survey of the organisation.

Identify: top-down strategic analysis of the organisation followed by identification of information resources and information flow.

Analyse: analysis and evaluation of identified information resources and formulation of action plans.

Account: cost/value analysis of information resources.

Synthesise: reporting on the audit and development of the organisation information strategy.

Buchanan & Gibb (2007) specify the scope of an information audit as two dimensional, with Earl's (2000) four components of information strategy the first dimension, and organisational 'perspective' the second, further specified as strategic, process, and resource perspectives respectively. While process focuses on functions and associated information flow, and resource focuses on identification, classification, and evaluation of information resources, strategic focuses on the realisation of strategic goals through mapping and analysis of the relationship between organisational mission and associated information resources. Typical questions to be answered by a strategic oriented information audit would include: what is our mission, how can we achieve this, what is essential to our success, what information resources do we use/require, are there any gaps or constraints, and were can we use information resources to our advantage?

The Buchanan & Gibb (1998) information audit methodology includes (as part of identify and analyse) steps to identify and define the organisations mission, environment, structure, culture, information flow and information resources, and to then evaluate information resources according to strategic importance and utility, and formulate action plans. Following this top-down approach allows hierarchical relationships to be mapped from mission to objectives to organisational function to information resources, and enables a corresponding value to be assigned to information resources in relation to the function supported (on a scale ranging from [1] not used or has no perceived benefit, to [5] critical to function). Reference is also made by Buchanan & Gibb to established business analysis tools common to strategic planning (see Figure 7), which provide a simple, visual method by which to stimulate strategic thinking within working groups (a common and recommended approach to strategic analysis and planning). These tools can be criticised as overly simplistic, but this is largely due to inappropriate extended use. As a tool to initiate more detailed analysis and planning, they can be highly effective. For example: the Boston Consulting Group product portfolio matrix (Henderson, 1970) can be used to distinguish between low and high growth digital services relative to market/audience demand, and plot position relative to alternative providers; McFarlan and McKenney's (1983) Strategic Grid to assess individual information resources,

identifying their current and future strategic importance (in relation to digital services); and the Technology S-curve, derived from Rogers (1962) diffusion of innovation theory, to understand and evaluate key stages of technology adoption and diffusion (Bowden, 2004), and proactively manage technology lifecycles (for example, e-book readers).

Take in Figure 7.

Undertaking an information audit either as a precursor to strategic planning, or incorporated within the *review* and *formulate* stages of the planning process (see Figure 1), will assist in ensuring that a library's information resources are effectively identified and utilised in pursuit of strategic goals, and that the opportunity offered by new technology is fully considered and exploited when setting these goals. Information audit output can provide direct input to the *scope*, *business model*, and *system model* rows of the Zachman framework (see Table 1), and establish or contribute to TOGAF ADM (see Figure 4) architectural baselines for the TOGAF ADM (Buchanan & Gibb, 2007).

THE ROLE OF SYSTEMS' THINKING

The relationship between strategy and architecture is complex, being interdependent and multidimensional. There are dynamic environmental factors to consider, organisational processes and procedures to understand, information resources to identify and evaluate, and new technology to consider, both strategically and architecturally (in terms of organisational 'fit'). Such complexity requires a holistic perspective, as encouraged by the practice of systems' thinking.

In simple terms, a system is defined as a collection of entities linked together in a regulated set of relationships to form a complex whole. Examples could include organisational and biological systems. However, for our purposes, a system is defined as a set of logical, related components (consisting of people, technology, inputs, processes, and outputs within a system boundary) brought together to accomplish a predefined organisational goal, which is achieved primarily through the processing of information.

Systems' thinking recognises that systems have emergent properties that would not exist if their component parts were not linked together (potentially transcending functional boundaries), and that any reasonably complex system will contain various sub-systems. Systems' thinking recognises that every system has a boundary, outside of which exists the system environment, where there are elements that

affect the system, but which cannot be controlled by the system. The starting point for the analysis or design of a system is to determine what is inside the system, and what is outside the system, but part of its environment.

Notably, within systems theory there are two perspectives regarding the fundamental nature of systems and how they should be defined, modelled, and measured: a hard systems view advocated by engineering and technical professions that maintains that systems are tangible; and a soft systems view advocated by social science professions that argues that systems are partly based on ideas, or models of the world, with only parts of these systems represented by objects in the physical world. In truth both perspectives provide useful insights into the processes and information flow that underpin an organisation, because effective systems must be designed and built in response to the needs of the organisation and its environment. Consequently, they must take into account complex social, economic, organisational, and ergonomic requirements and relationships, as well as being technically and logically sound.

A recent evaluation of the usability and usefulness of a UK National Health Service digital library (Buchanan & Salako, 2009) illustrates this point. The digital library had been developed to provide clinicians with direct access to clinical evidence and best practice recommendations to support decision-making at the point of care, and to support ongoing professional development. At the time of evaluation it had only recently been launched. Participants in the study (clinicians) found the digital library to be usable from a design standpoint, but not particularly useful, questioning its purpose in relation to existing e-library services, and more importantly, how it might be used under variable clinical conditions and settings (e.g. on ward rounds). The study highlighted the importance of cognitive and contextual considerations to system design (beyond the interface), and the importance of accounting for variable user scenarios. In a follow-on study (Buchanan & McMenemy, 2009), a systems thinking approach was adopted to demonstrate how process modeling of the clinical consultation process facilitated better understanding of activity to be supported, and assisted with the identification of those environmental conditions and constraints which influence use. Such an approach not only provided the required holistic perspective, but the resultant process models could be used to inform business architecture, and to guide associated data, application, and technology architectures.

CONCLUSION

In an era of unprecedented technological innovation and evolving user expectations and information seeking behaviour, we are now arguably an online society, with digital information services increasingly common and increasingly preferred. As a trusted source of information, libraries are in an advantageous position to respond, but this requires integrated strategic and architectural planning, which while challenging, should be regarded as an opportunity to evolve as an enterprise in the digital age, or as a minimum, to simply keep pace with societal change and alternative service providers.

Enterprise architecture extends strategic planning to IT architecture, facilitating strategic and architectural alignment, distinguishing between low and high growth digital services, identifying current and future strategic importance of associated information resources, and proactively managing technology lifecycles. Beyond the strategic imperative, there are significant financial and operational benefits to be realised, including: better returns on existing IT investments; reduced new investment risk; lower development, support, and maintenance costs; increased portability of applications; and improved ability to address critical enterprise-wide issues.

Strategic planning is presented as a four-stage cyclical process of *review*, *formulate*, *implement*, and *evaluate*; with a relationship from strategy to enterprise architecture provided via Earl's (2000) information strategy taxonomy, which can be mapped to the four-subset architectures of The Open Group Architectural Framework (TOGAF). TOGAF extends Earl's taxonomy, providing a methodology which bridges the gap between strategy formulation and architectural planning and development. The Zachman framework can assist with requirements specification, providing a framework for comprehensively and systematically capturing both user need and context of use, while the information audit can be utilised to identify and evaluate existing information resources. Systems' thinking provides the necessary overarching holistic perspective.

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Figure 1. The strategic planning process

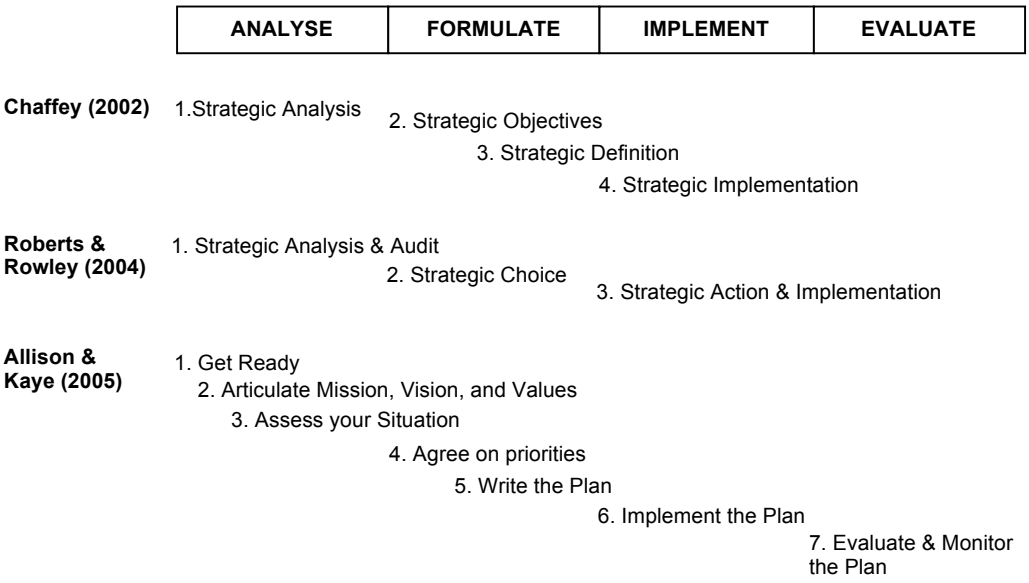

Figure 2. The components of information strategy (adapted from Earl, 1989, 2000)

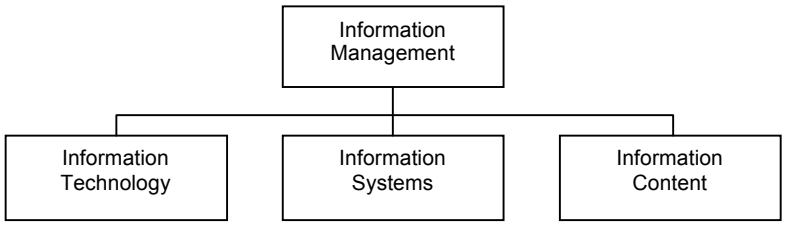

Figure 3. A framework for information strategy formulation (adapted from Earl, 1989)

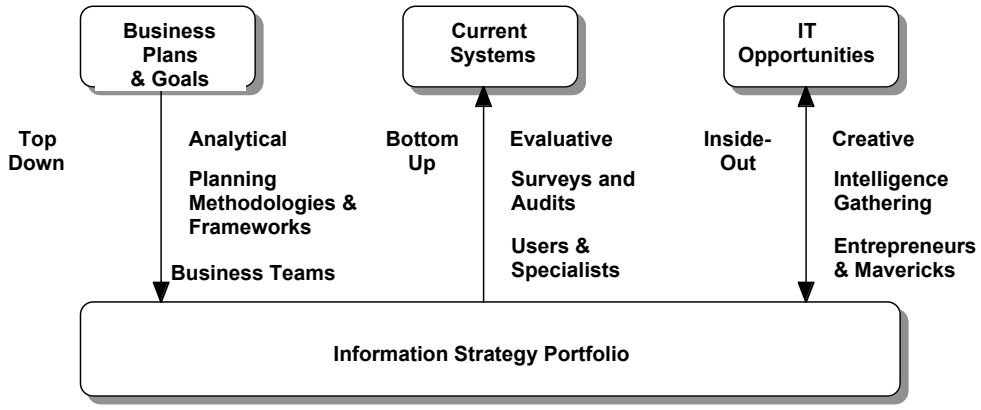

Figure 4. TOGAF Application Development Method (TOGAF, 2006)

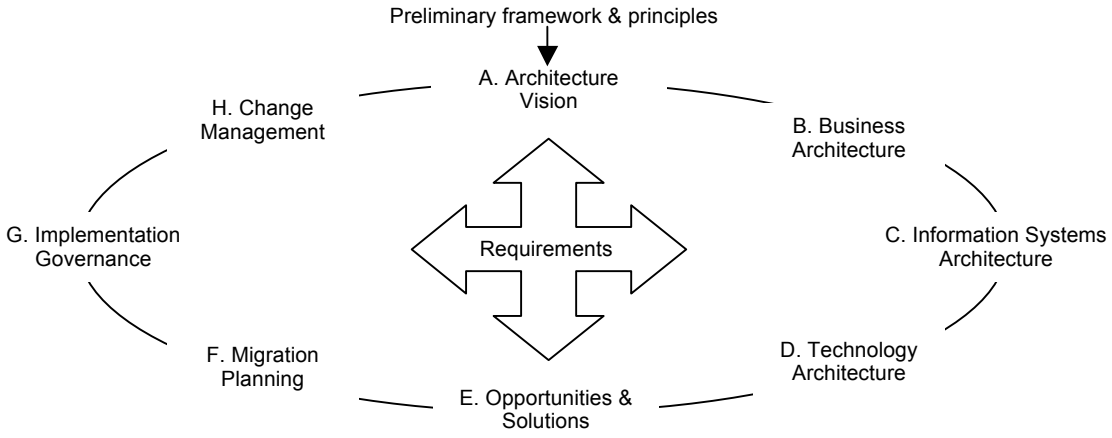

Figure 5. The Architecture Continnum (adapted from TOGAF, 2006)

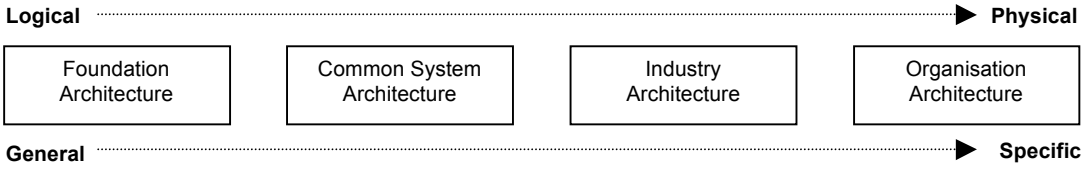

Figure 6. Information Strategy and Enterprise Architecture (Buchanan & Gibb, 2007)

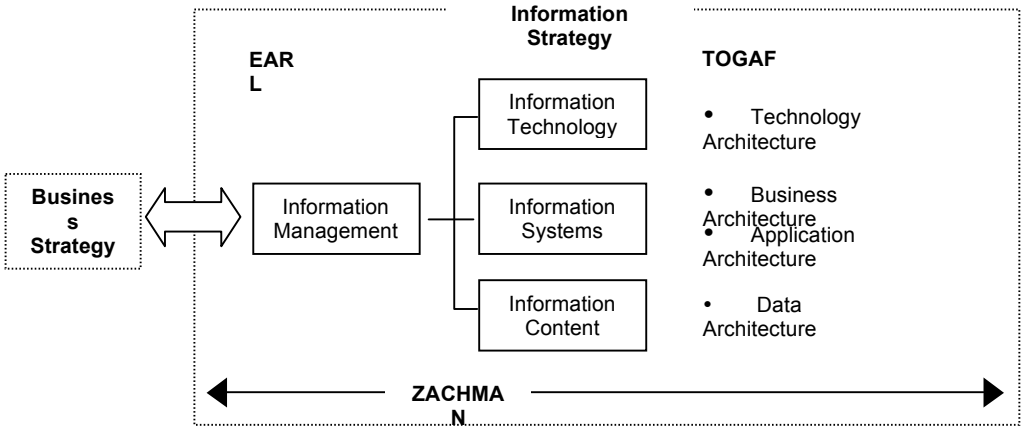

Figure 7. Business analysis frameworks